005755

United States Department of Energy

Savannah River Site

Record of Decision
Remedial Alternative Selection for the D-Area Oil Seepage Basin (631-G) (U)

WSRC-RP-97-402

Revision 1, Final

August 1998

Westinghouse Savannah River Company
Savannah River Site
Aiken, SC 29808

Prepared for the U. S. Department of Energy under Contract No. DE-AC09-96SR18500

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Prepared for
U. S. Department of Energy
By
Westinghouse Savannah River Company
Aiken, South Carolina

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DECLARATION FOR THE RECORD OF DECISION

Unit Name and Location

D-Area Oil Seepage Basin (Building Number 631-G)

Savannah River Site

Aiken, South Carolina

The D-Area Oil Seepage Basin (D-Area OSB) Operable Unit (OU) is listed as a Resource Conservation and Recovery Act (RCRA) 3004(u) Solid Waste Management Unit/Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) unit in Appendix C of the Federal Facility Agreement (FFA) for the Savannah River Site (SRS).

Statement of Basis and Purpose

This decision document presents the selected remedial alternative for the D-Area OSB located at SRS south of Aiken, South Carolina. The selected alternative was developed in accordance with CERCLA, as amended, RCRA, and to the extent practicable, the National Oil and Hazardous Substances Contingency Plan (NCP). This decision is based on the Administrative Record File for this specific RCRA/CERCLA unit.

Assessment of the Site

Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in this Record of Decision (ROD), may present an imminent and substantial endangerment to public health, welfare, or the environment.

Description of the Selected Remedy

Since remedial action objectives (RAOs) for deep soils have been achieved by the interim remedial action (IRA) and biovent testing, No Further Action is the selected remedy for this medium (WSRC, 1997b, c, d, and e). No Action is the selected remedy for shallow soil, surface water and sediment, because no constituents of concern (COCs) were identified for them in the RCRA Facility Investigation/ Remedial Investigation/ Baseline Risk Assessment (RFI/RI/BRA). For these reasons, development of remedial alternatives for these media is not warranted.

The selected remedy for D-Area OSB groundwater is Alternative GW-2: Natural Attenuation/Groundwater Mixing Zone (GWMZ) with Institutional Controls. Under this remedy, natural attenuation mechanisms such as biodegradation, flushing, volatilization, adsorption, and hydrolysis would continue to reduce contaminant concentrations in the groundwater to acceptable levels. Results from a bioventing study, conducted after the IRA at the unit, indicate that the source of groundwater contamination (i.e., the D-Area OSB soil) was abated as a result of the combined IRA and biovent test and no longer contributes to groundwater contamination. Evidence indicating that natural attenuation processes are occurring in the D-Area OSB groundwater was presented in the RFI/RI/BRA Report (WSRC, 1997a) for the unit. This evidence included: (1) decreased dissolved oxygen levels in the groundwater, indicating that microorganisms are utilizing the contaminants as a carbon source and the oxygen within the groundwater to produce energy, (2) elevated chemical oxygen demand, chloride, and sulfate levels downgradient, (3) depressed pH levels in contaminated areas, and (4) presence of breakdown products.

Herbert et al., 1984, report that natural attenuation is selected as a preferred remedial option when the following site-specific conditions exist:

- Groundwater is unsuitable for consumptive use.
- Contaminants degrade quickly or are not at highly toxic concentrations.
- There is low potential for exposure.
- Active restoration is not feasible due to complex hydrogeologic conditions.
- There is low projected demand for future groundwater use.
- The unit is in close proximity to a surface water discharge area, with dilution to levels that are protective of human health and the environment.

Based on the information presented in the RFI/RI/BRA report for the D-Area OSB, the conditions at the D-Area OSB would be conducive to natural attenuation. Specific findings from that report include:

- The source of contamination at the D-Area OSB was removed during the IRA in conjunction with the biovent testing and is no longer contributing to groundwater contamination.
- Naturally occurring mechanisms will continue to reduce contaminant concentrations.
- There are no receptors of groundwater at the D-Area OSB; therefore, the potential for exposure is low.
- The aquifer is limited in thickness and yield and the groundwater it contains is not targeted for residential or commercial use; therefore, projected demand for future groundwater use is low.
- Modeling indicates that contaminant concentrations in the D-Area OSB groundwater would be reduced to below maximum contaminant levels (MCLs) prior to reaching Fourmile Branch; therefore dilution in the surface water body is not necessary to achieve MCLs.

The time required to degrade the unit-specific contaminants was conservatively estimated through groundwater modeling. The modeling indicates that all contaminant concentrations in groundwater would be reduced below their respective MCLs within approximately 10 years, which is well within the time-frame that the U.S. Department of Energy (DOE) plans to maintain control of the SRS.

A GWMZ application, defined under South Carolina Regulations R.61-68, has been approved by the SCDHEC as part of this alternative. Based on area characteristics and evidence presented in the GWMZ Application (WSRC, 1998c), a GWMZ variance for the D-Area OSB is an appropriate part of natural attenuation remedies.

Mixing zones are appropriate for situations where the source of groundwater contamination has been removed and where contaminant concentrations are being reduced by natural processes. Under these regulations, certain concentration limits above MCLs, known as mixing zone concentration limits (MZCLs), will be established within the designated mixing zone, where the plume will migrate while it dissipates. MCLs, which are protective limits for drinking water, will be established at the compliance boundary downgradient of the plume. Plume monitoring wells will be installed within the plume and at the compliance boundary, and would be sampled periodically to monitor compliance with permitted MCLs and MZCLs. Intermediate wells will be installed at other locations within the mixing zone to monitor plume behavior between the plume wells and compliance boundary wells as an early warning mechanism if plume behavior does not match predictions.

The mixing zone application has demonstrated that RAOs will be met, MZCLs will be achieved throughout the groundwater aquifer, and MCLs will be achieved at the compliance boundary as described in the approved GWMZ application. Implementation of this alternative will involve installation of nine new wells and monitoring of a total of 12 groundwater wells, as described in the GWMZ application.

The D-Area OSB is in an industrial use zone, as identified in Figure 3.3 of the SRS FFA Implementation Plan (WSRC, 1996e), for both current and anticipated future land use. Although the remediation decisions for this unit were based on the industrial use scenario, the groundwater remedy will achieve the more protective residential use scenario. The D-Area OSB currently meets unrestricted land use criteria for soils, sediment and surface water. Groundwater beneath the unit exceeds the MCLs. Although institutional controls are included in all of the alternatives (except the no-action alternative), the DOE has recommended that residential use of SRS land in the vicinity of D Area be prohibited (DOE, 1996); therefore, future residential use and potential residential water usage in this area is unlikely. Modeling of groundwater transport processes as part of the evaluation of the remedial alternatives indicates that MCLs for the contaminants of concern will be achieved in all areas of the D-Area OSB groundwater after approximately 10 years. Upon confirmation that MCLs have been achieved, institutional controls at the unit will no longer be required.

Per the EPA Region-IV Land Use Controls (LUCs) Policy, a LUC Assurance Plan (LUCAP) for SRS and a LUC Implementation Plan (LUCIP) for the D-Area OSB will be developed and submitted to the regulators for approval. The LUCAP will be submitted under separate cover, whereas the LUCIP will be submitted with the Remedial Design Work Plan/Remedial Design Report/Remedial Action Work Plan (RDWP/RDR/RAWP) in accordance with the post-ROD document schedule provided in Figure 18. The LUCIP details how SRS will implement, maintain, and monitor the land use control elements of the D-Area OSB ROD to insure that the remedy remains protective of human health.

The LUC objective necessary to ensure the protectiveness of the preferred alternative is:

- Prevent unauthorized access to the D-Area OSB contaminated groundwater plume.

The institutional controls required to prevent unauthorized exposure to the contaminated media at the D-Area OSB include the following:

- controlled access to the D-Area OSB through existing SRS security gates and perimeter fences and the site use/site clearance programs
- signs posted in the area to indicate that groundwater in the vicinity of the unit has been contaminated by hazardous materials
- notification of groundwater contamination to any future landowner through deed notification, as required under CERCLA Section 120(h)

A certified survey plat of the site will be prepared by a registered land surveyor and will be included with the post-ROD documents. If D-Area OSB is transferred to non-Federal ownership prior to remediation of the groundwater to the MCLs for the COCs, reevaluation of the need for deed restrictions would be performed through an amended ROD with Environmental Protection Agency (EPA) and South Carolina Department of Health (SCDHEC) approval. The survey plat will be reviewed and updated, as necessary, at the time the site is transferred and will be recorded with the appropriate county recording agency. The D-Area OSB is located in Aiken County.

This selected remedy is intended to be the final action for the D-Area OSB, and is intended to be permanent and effective in both the long and short terms. This remedy is considered to be the least cost option that is still protective of human health and the environment. The state regulatory authority, the SCDHEC, will modify the SRS RCRA permit to incorporate the selected remedy.

The Rev. 0 of the post-ROD document, the combined RDWP/RDR/RAWP, will be submitted to the U.S. EPA and SCDHEC within approximately 180 calendar days after the issuance of the ROD. The RDWP/RDR/RAWP will contain a conceptual Corrective Action Plan Strategy, a summary description of the scope of work for the remedial action design, an implementation/ submittal schedule for subsequent post-ROD documents, and an anticipated field activities start date. The regulatory review period, SRS revision period, and final regulatory review and approval period will be 90, 60, and 30 calendar days, respectively.

Statutory Determinations

Based on the D-Area OSB RFI/RI Report and BRA (WSRC, 1997a), D-Area OSB groundwater poses no significant risk to the environment but poses significant risk to human health. Therefore, monitoring of the existing groundwater constituents, consistent with the GWMZ application, is necessary.

The selected remedy is protective of human health and the environment, complies with federal and state requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost-effective. This remedy utilizes permanent solutions and alternative treatment (or resource recovery) technology to the maximum extent practicable and satisfies the statutory preference for remedies that employ treatment to reduce toxicity, mobility, or volume as a principal element. Section 300.430(f)(4)(ii) of the NCP requires that a five-year review of the ROD be performed if hazardous substances, pollutants, or contaminants remain at the waste unit. Since hazardous substances will remain at the unit above health-based standards during the remediation time frame indicated in the groundwater mixing zone application (approximately 10 years), the three FFA Parties below have determined that a five-year review of the ROD for the D-Area OSB will be performed to ensure continued protection of human health and the environment until the MCLs are attained in the groundwater.

8/26/98
Date

T. F. Heenan; Assistant Manager for Environmental Quality
U. S. Department of Energy, Savannah River Operations Office

10/19/98
Date

Richard D. Green; Division Director
Waste Management Division
U. S. Environmental Protection Agency - Region IV

3/4/99
Date

R. Lewis Shaw; Deputy Commissioner
Environmental Quality Control
South Carolina Department of Health and Environmental Control

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RECORD OF DECISION

REMEDIAL ALTERNATIVE SELECTION (U)

D-Area Oil Seepage Basin (631-G)

WSRC-RP-97-402

Revision 1, Final

August 1998

Savannah River Site

Aiken, South Carolina

Prepared by:

Westinghouse Savannah River Company

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Savannah River Operations Office

Aiken, South Carolina

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DECISION SUMMARY

REMEDIAL ALTERNATIVE SELECTION (U)

D-Area Oil Seepage Basin (631-G)

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Savannah River Operations Office

Aiken, South Carolina

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LIST OF ACRONYMS AND ABBREVIATIONS

ARAR	applicable or relevant and appropriate requirement
BRA	Baseline Risk Assessment
CAB	Citizen's Advisory Board
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CMS	Corrective Measures Study
COC	constituent of concern
COPC	constituent of potential concern
CSM	conceptual site model
D-Area OSB	D-Area Oil Seepage Basin
DCE	dichloroethene
DOE	U.S. Department of Energy
DQO	Data Quality Objectives
DRO	diesel range organics
EPA	U.S. Environmental Protection Agency
ERA	Ecological Risk Assessment
ER&WM	Environmental Remediation and Waste Management
ESC	Expedited Site Characterization
FFA	Federal Facility Agreement
FRR	Final Remediation Report
FS	Feasibility Study
ft	feet/foot
GWMZ	Groundwater Mixing Zone
H_c	Henry's Law coefficient
HI	hazard index
HQ	hazard quotient
IRA	interim remedial action
LUC	land use control
LUCAP	land use control assurance plan
LUCIP	land use control implementation plan
km	kilometer
m	meter

MCL	maximum contaminant level
MEPAS	Multimedia Environmental Pollutant Assessment System
mi	mile
µg/kg	micrograms per kilogram
µg/l	microgram per liter
MLSSL	mass-limited soil screening level
msl	mean sea level
MZCL	mixing zone concentration limit
NCP	National Oil and Hazardous Substances Contingency Plan
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
OU	Operable Unit
PCE	tetrachloroethene
PCOC	Preliminary COC
PCR	post-construction report
PP	Proposed Plan
RAO	Remedial Action Objective
RAWP	Remedial Action Work Plan
RBC	risk-based concentration
RCRA	Resource Conservation and Recovery Act
RDR	Remedial Design Report
RDWP	Remedial Design Work Plan
RFI	RCRA Facility Investigation
RGO	remedial goal option
RI	CERCLA Remedial Investigation
RME	Reasonable Maximum Exposure
ROD	Record of Decision
SAFER	Streamlined Approach for Environmental Restoration
SB	Statement of Basis
SCDHEC	South Carolina Department of Health and Environmental Control
SCHWMR	South Carolina Hazardous Waste Management Regulations
SRS	Savannah River Site
SSL	soil screening level
TCE	trichloroethene
TPH	total petroleum hydrocarbons

USC	unit-specific constituent
VOC	volatile organic compound
WSRC	Westinghouse Savannah River Company

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I. SAVANNAH RIVER SITE (SRS) AND OPERABLE UNIT (OU) NAME, LOCATION, DESCRIPTION, AND PROCESS HISTORY

SRS Location, Description, and Process History

The SRS occupies approximately 777 square kilometers (km) [310 square miles (mi)] of land adjacent to the Savannah River, principally in Aiken and Barnwell counties of South Carolina (Figure 1). SRS is a secured U.S. Government facility with no permanent residents. SRS is located approximately 40 km (25 mi) southeast of Augusta, Georgia, and 32 km (20 mi) south of Aiken, South Carolina.

SRS is owned by the U.S. Department of Energy (DOE). Management and operating services are provided by Westinghouse Savannah River Company (WSRC). SRS has historically produced tritium, plutonium, and other special nuclear materials for national defense. Chemical and radioactive wastes are by-products of nuclear material production processes.

OU Name, Location, Description, and Process History

The Federal Facility Agreement (FFA) (WSRC, 1993a) lists the D-Area Oil Seepage Basin (D-Area OSB), Building Number 631-G, as a Resource Conservation and Recovery Act (RCRA)/Comprehensive Environmental Compensation and Liability Act (CERCLA) unit requiring further evaluation using an investigation/assessment process that integrates and combines the RCRA Facility Investigation (RFI) process with the CERCLA Remedial Investigation (RI) to determine the actual or potential impact to human health and the environment. Information regarding the D-Area OSB can be found in the RFI/RI Report and Baseline Risk Assessment (BRA) (WSRC, 1997a), the Corrective Measures Study/Feasibility Study Report (CMS/FS) (WSRC, 1998a), and the Statement of Basis/Proposed Plan (SB/PP) (WSRC, 1998b).

The D-Area OSB is located within SRS, in a clearing between roads A-4.4 and A-4.5, approximately 1.6 km (1 mi) north of the coal-fired D-Area Powerhouse, and approximately 3.1 km (1.9 mi) from the nearest SRS boundary (Figures 2 and 3). The D-Area OSB is on the Ellenton Plain along the Savannah River at an elevation of 46 meters (m) [150 feet (ft)] above mean sea level (msl). The water table ranges from approximately 1 to 5 m (4 to 16 ft) below ground surface in the area of the D-Area OSB. Surface drainage is to the southwest, toward the Savannah River, which is at an elevation of 26 m (85 ft) msl [20 m (65 ft) below the basin elevation].

The D-Area OSB is designated as Building Number 631-G and has the approximate dimensions of 117 m (383 ft) long by 33 m (108 ft) wide and 2.5 m (8 ft) deep. During an interim remedial action (IRA) conducted at the unit, the trenches were found to be continuous, without noticeable berms, and were constructed as a series of adjacent trenches along the back half of the clearing (Figure 3).

The D-Area OSB unit is located in a cleared, rectangular-shaped area adjacent to an unimproved road in D Area (Figure 4). The location of the former seepage basin is currently not discernible because the unit has been backfilled and leveled. The only evidence of the unit's prior existence is the four orange balls marking the corners of the unit, a perimeter fence, and the presence of multiple monitoring wells and piezometers located at or near the unit. The terrain is flat, with no discernible slope or relief, and is surrounded by a mature forest of hardwoods and softwoods. The forested conditions provide dense cover for wildlife, and, in combination with the boggy conditions prevailing in the adjacent wetlands, create access problems for equipment and personnel involved in unit investigation activities.

The closest surface water feature is a Carolina bay, a natural wetland located adjacent to the unit to the west. The Carolina bay appears to be dry during the summer months or periods of little or no precipitation, but may contain surface water during wet seasons. Unimproved dirt road A-4.4, located immediately north of the waste unit, bisects the Carolina bay. Aerial photographs indicate that the road was in existence during the early 1950s. Other wetlands exist approximately 76 m (250 ft) to the south of the unit, beyond dirt road A-4.5.

The major local surface water drainage system is the Savannah River and associated swamps, located approximately 2.6 km (1.6 mi) to the west of the basin. Upper Three Runs Creek, a tributary to the Savannah River, is located 2.7 km (1.7 mi) to the north-northwest, and Fourmile Branch, another tributary, is 2.7 km (1.7 mi) to the south-southeast (Figure 1). The local surface drainage at the unit is to the south-southwest, toward a wetland area and runoff ditch. These wetlands discharge into another unnamed ditch, which traverses D Area and eventually leads to the Savannah River.

The D-Area OSB was constructed in 1952 as a series of unlined trenches for disposal of waste oil products, from D Area and other areas at SRS, which were unacceptable for incineration in the 400-D powerhouse boilers. As the trenches filled, the waste oils along with general office and cafeteria waste were occasionally ignited. The practice of open burning was a common practice at SRS until 1973 when it was stopped site-wide. In 1975 the basin was removed from service and was backfilled with soil.

The basin remained inactive and covered with natural vegetation, including bushes and grasses, until 1996, when an IRA was implemented. During the IRA, the trench area was excavated and drums and debris were removed along with any obviously contaminated soils. The remaining soils were returned to the excavation in "last out, first in" order.

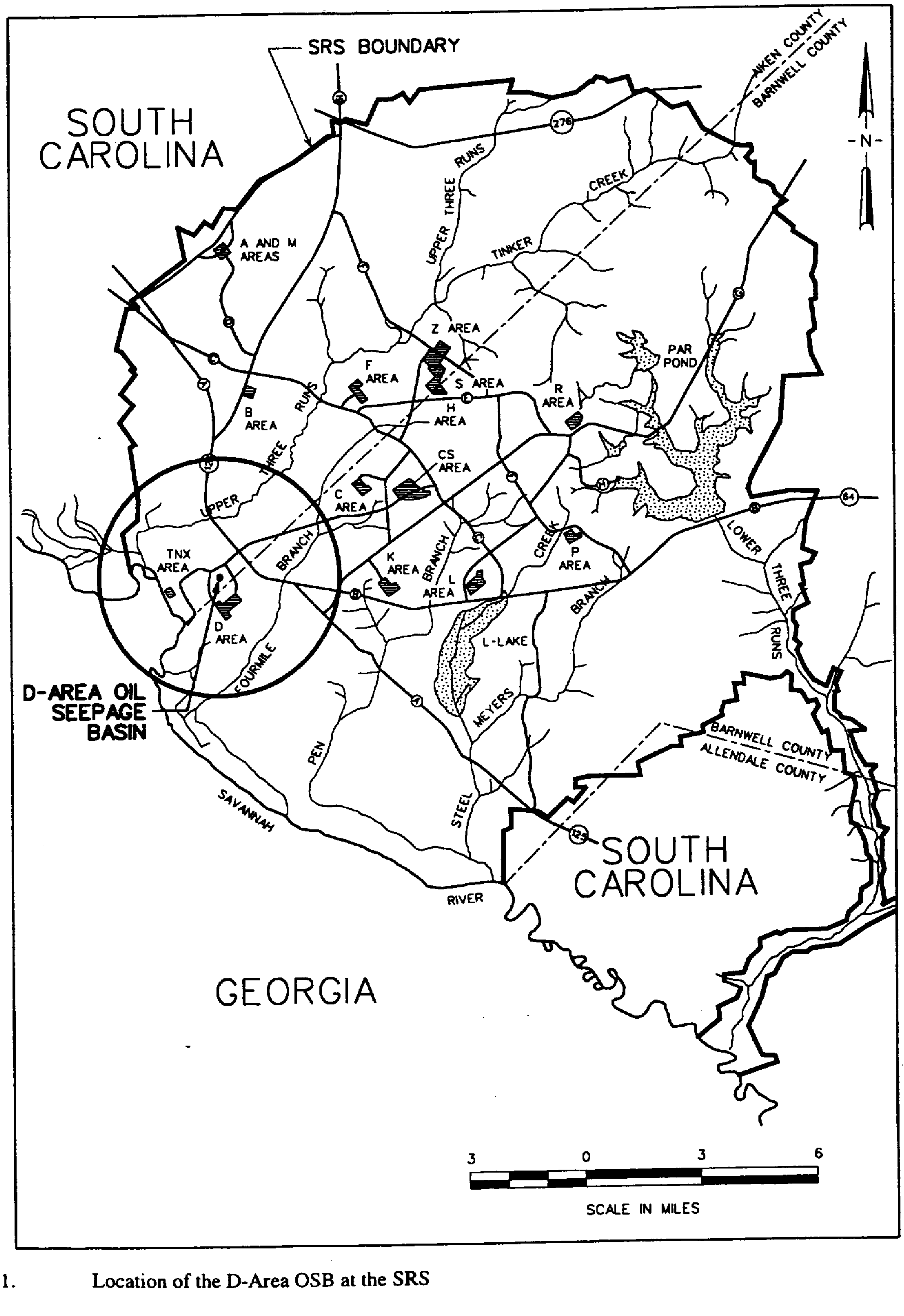

Figure 1. Location of the D-Area OSB at the SRS

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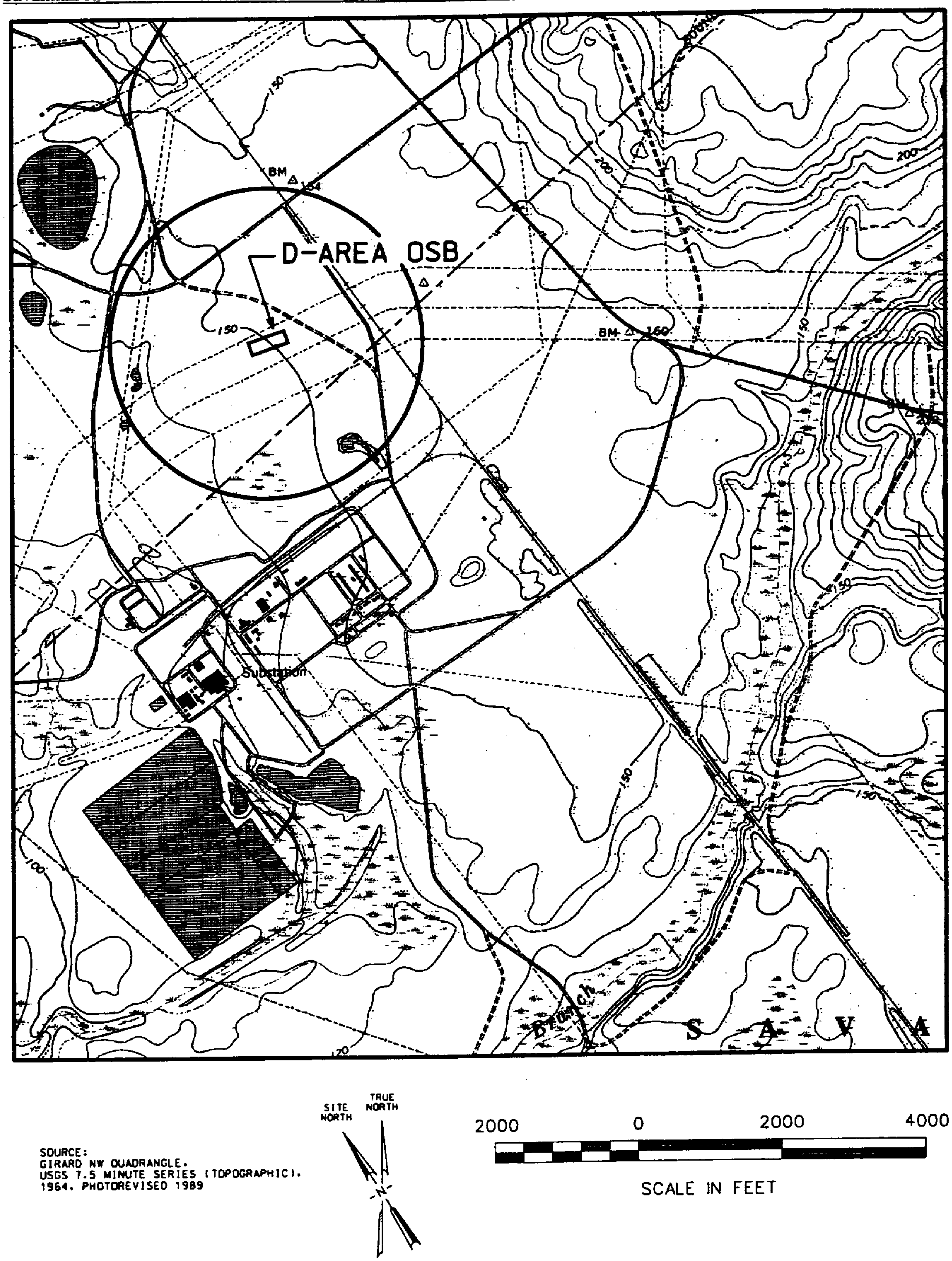

Figure 2. Topography of the Area Surrounding the D-Area OSB

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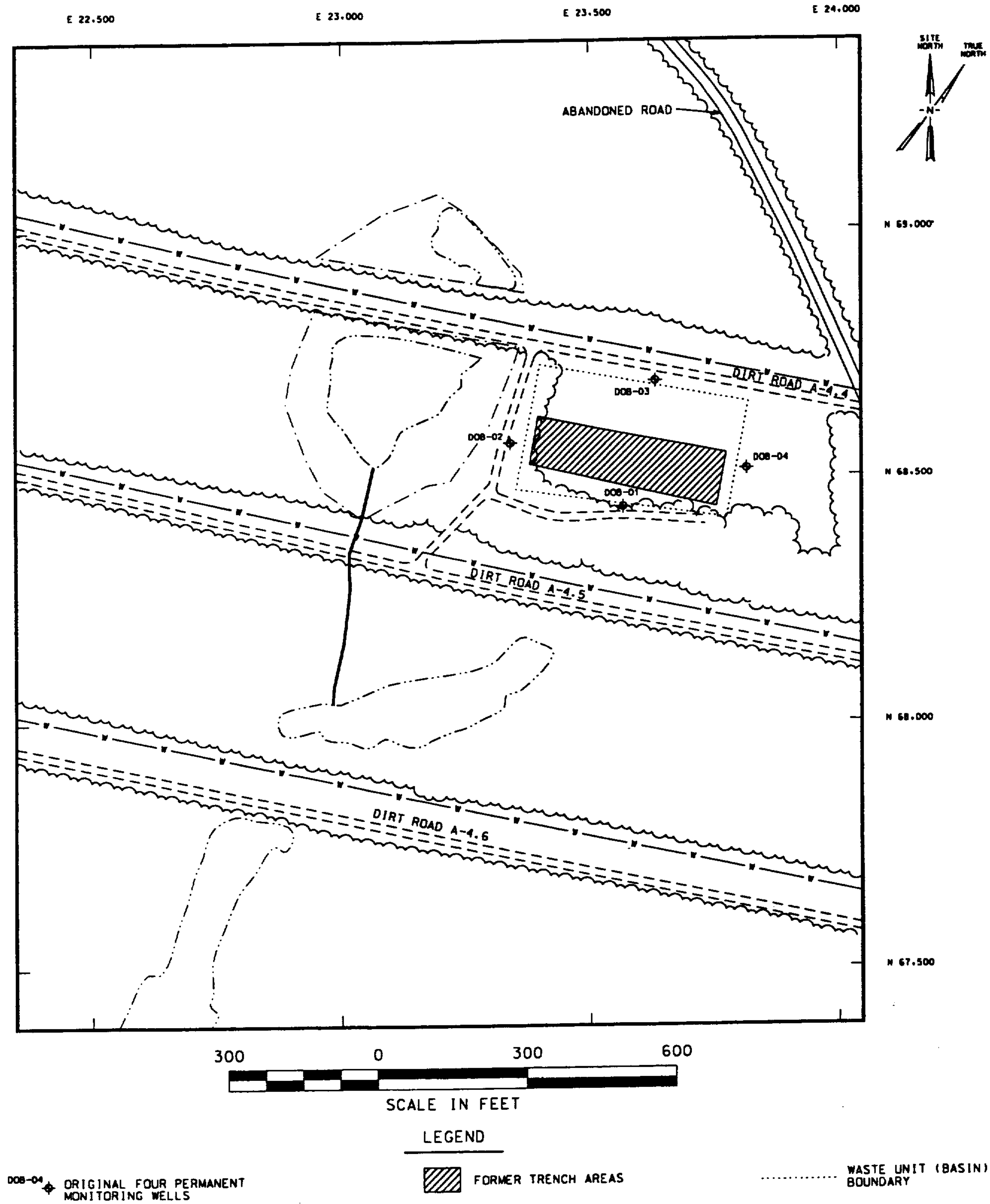

Figure 3. Site Plan of the D-Area OSB

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Figure 4. Current Photograph of the D-Area OSB (May 1998)

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At the close of the IRA, the contractor installed two horizontally oriented, perforated pipes along the length of the former waste unit for technology testing (bioventing) purposes. These pipes were used to force fresh air, nutrients and tracers into the soils at a depth of about 2.4 m (8 ft) in order to volatilize the constituents in the soil, enhance the aerobic degradation of the constituents in both the soil and groundwater, and monitor the effectiveness of the treatment program (WSRC, 1997b, c, d, e).

II. SITE AND OU COMPLIANCE HISTORY

SRS Operational History

The primary mission of SRS has been to produce tritium (^{3}H), plutonium-239 (^{239}Pu), and other special nuclear materials for our nation's defense programs. Production of nuclear materials for the defense programs was discontinued in 1988. SRS has provided nuclear materials for the space program, as well as for medical, industrial, and research efforts up to the present. Chemical and radioactive wastes are by-products of nuclear material production processes. These wastes have been treated, stored, and in some cases, disposed at SRS. Past disposal practices have resulted in soil and groundwater contamination.

SRS Compliance History

Waste materials handled at SRS are regulated and managed under RCRA, a comprehensive law requiring responsible management of hazardous waste. Certain SRS activities have required federal operating or post-closure permits under RCRA. SRS received a hazardous waste permit from the South Carolina Department of Health and Environmental Control (SCDHEC); the permit was most recently renewed on September 5, 1995. Part IV of the permit mandates that SRS establish and implement an RFI Program to fulfill the requirements specified in Section 3004(u) of the federal permit.

On December 21, 1989, SRS was included on the National Priorities List (NPL). Sites included on the NPL fall under the jurisdiction of CERCLA. This inclusion created a need to integrate the established RFI Program with CERCLA requirements to provide for a focused environmental program. In accordance with Section 120 of CERCLA, DOE has negotiated a FFA (WSRC, 1993a) with the U.S. Environmental Protection Agency (EPA) and SCDHEC to coordinate remedial activities at SRS into one comprehensive strategy that fulfills these dual regulatory requirements.

OU Compliance History

As previously stated, the D-Area OSB is listed in the FFA as a RCRA/CERCLA unit requiring further evaluation to determine the actual or potential impact to human health and the environment. An RFI/RI characterization and BRA were conducted for the unit between 1995 and 1996. The results of the RFI/RI and BRA were presented in the RFI/RI Report and BRA (WSRC, 1997a). The RFI/RI Report and BRA were submitted in accordance with the FFA and the approved implementation schedule, and were approved by EPA and SCDHEC in August 1997. SRS submitted the *Revision 0 Interim Action Proposed Plan* for the D-Area OSB, which EPA and SCDHEC received November 26, 1993. The three Parties issued the *Interim Action Record of Decision* in March 1995. SRS prepared and submitted the D-Area OSB *Interim Action Post-Construction Report* to EPA and SCDHEC on November 8, 1996. SCDHEC approved the report on January 7, 1997, and EPA approved it on February 27, 1997. The CMS/FS (WSRC, 1998a), SB/PP (WSRC, 1998b), and *Groundwater Mixing Zone Application* (WSRC, 1998c) were submitted to EPA and SCDHEC in accordance with the FFA and the approved implementation schedule, and were approved by them on April 1, 1998.

III. HIGHLIGHTS OF COMMUNITY PARTICIPATION

Both RCRA and CERCLA require that the public be given an opportunity to review and comment on the draft permit modification and proposed remedial alternative. Public participation requirements are listed in South Carolina Hazardous Waste Management Regulation (SCHWMR) R.61-79.124 and Sections 113 and 117 of CERCLA. These requirements include establishment of an Administrative Record File to document the investigation and selection of the remedial alternatives for addressing the D-Area OSB soils and groundwater. The Administrative Record File must be established at or near the facility at issue. The SRS Public Involvement Plan (DOE, 1994) is designed to facilitate public involvement in the decision-making process for permitting, closure, and the selection of remedial alternatives. The SRS Public Involvement Plan addresses the requirements of RCRA, CERCLA, and the National Environmental Policy Act (NEPA). SCHWMR R.61-79.124 and Section 117(a) of CERCLA, as amended, require advertisement of the draft permit modification and notice of any proposed remedial action and provide the public an opportunity to participate in the selection of the remedial action. *The Statement of Basis/Proposed Plan for the D-Area Oil Seepage Basin* (WSRC, 1998b), a part of the Administrative Record File, highlights key aspects of the investigation and identifies the preferred action for addressing the D-Area OSB. The Administrative Record File is available at the EPA office and at the following locations:

U. S. Department of Energy
Public Reading Room
Gregg-Graniteville Library
University of South Carolina-Aiken
171 University Parkway
Aiken, South Carolina 29801
(803) 641-3465

Thomas Cooper Library
Government Documents Department
University of South Carolina
Columbia, South Carolina 29208
(803) 777-4866

Similar information is available through the repositories listed below:

Reese Library
Augusta State University
2500 Walton Way
Augusta, Georgia 30910
(706) 737-1744

Asa H. Gordon Library
Savannah State University
Tompkins Road
Savannah, Georgia 31404
(912) 356-2183

The public was notified of the public comment period through mailings of the *SRS Environmental Bulletin*, a newsletter sent to approximately 3500 citizens in South Carolina and Georgia, through notices in the *Aiken Standard*, the *Allendale Citizen Leader*, the *Augusta Chronicle*, the *Barnwell People-Sentinel*, and *The State* newspapers. The public comment period was also announced on local radio stations.

The 45-day public comment period began on May 1, 1998 and ended on June 14, 1998. However, no public comments were received during this period. The Environmental Remediation and Waste Management (ER&WM) Program subcommittee of the SRS Citizen's Advisory Board (CAB) was given a briefing on the preferred alternatives on May 6, 1998. The ER&WM subcommittee was supportive of the preferred alternative and made a motion to the full CAB at the May 18, 1998 meeting to accept the preferred alternative. This motion was accepted with no opposition. The subcommittee also commended the site's successful use of the bioventilation system in the remediation of the unit's subsurface soil. The Responsiveness Summary, provided in Appendix A of this Record of Decision (ROD), and the final RCRA permit will indicate that no comments were received.

IV. SCOPE AND ROLE OF THE OU WITHIN THE SITE STRATEGY

RCRA/CERCLA Programs at SRS

RCRA/CERCLA units (including the D-Area OSB) at SRS are subject to a multi-stage remedial investigation process that integrates the requirements of RCRA and CERCLA as outlined in the RFI/RI Program Plan (WSRC, 1993b). The RCRA/CERCLA processes are summarized on Figure 5. Figure 5 illustrates the investigation and characterization of potentially impacted environmental media (such as soil, sediment, surface water, and groundwater) comprising the waste unit and surrounding areas; the evaluation of risk to human health and the local ecological community; the screening of possible remedial actions to identify the selected technology that will protect human health and the environment; implementation of the selected alternative; documentation that the remediation has been performed competently; and evaluation of the effectiveness of the technology. The steps of this process are iterative in nature, and include decision points that involve concurrence between DOE (as owner/manager), EPA and SCDHEC (as regulatory oversight), and the public. The RCRA/CERCLA process as applied to the D-Area OSB is outlined below.

RFI/RI Work Plan

Prior experience in the Superfund program has identified a strong need for streamlining the remediation process (EPA, 1989a). To address this need, DOE has developed the Streamlined Approach for Environmental Restoration (SAFER) (Daily et al., 1992). DOE Headquarters identified the D-Area OSB as a pilot project for the implementation of SAFER and elected to design the D-Area OSB RFI/RI Work Plan using SAFER methodologies.

The SAFER program combines elements of two recognized processes developed for managing uncertainty at different points in the environmental restoration process: the data quality objectives (DQO) process, developed by the Quality Assurance Management Staff of EPA (Neptune et al., 1990) and the Observational Approach (OA), which is rooted in management of uncertainty in traditional geotechnical engineering applications (Peck, 1969). The OA provides a framework for managing uncertainty throughout the environmental restoration process, while the DQO process focuses on establishing the quality and quantity of data required to help make decisions at various points in the environmental restoration process. Description of the DQO process is found in *Data Quality Objectives Process for Superfund, Interim Final* (EPA, 1993).

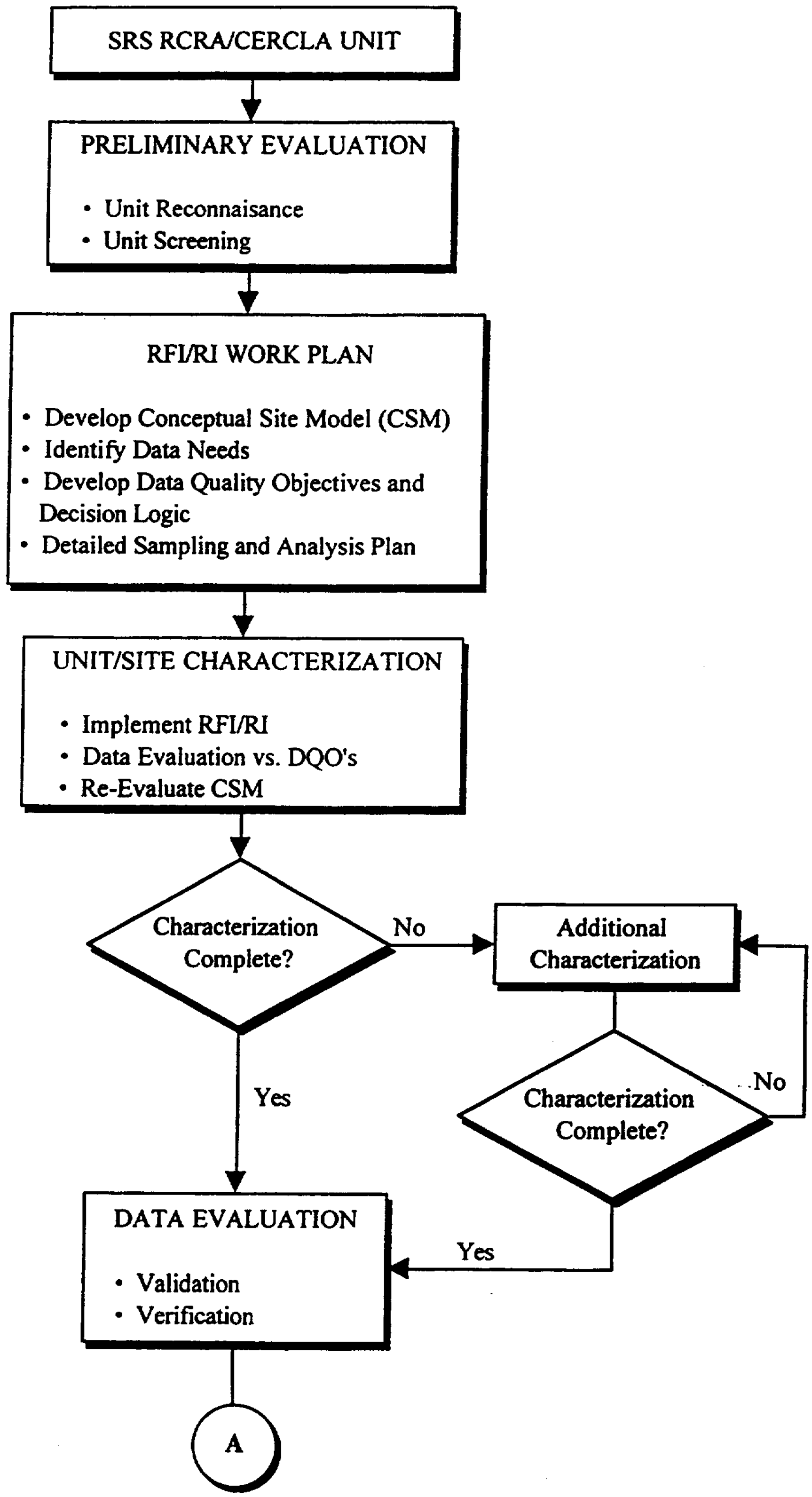

Figure 5. RCRA/CERCLA Logic and Documentation

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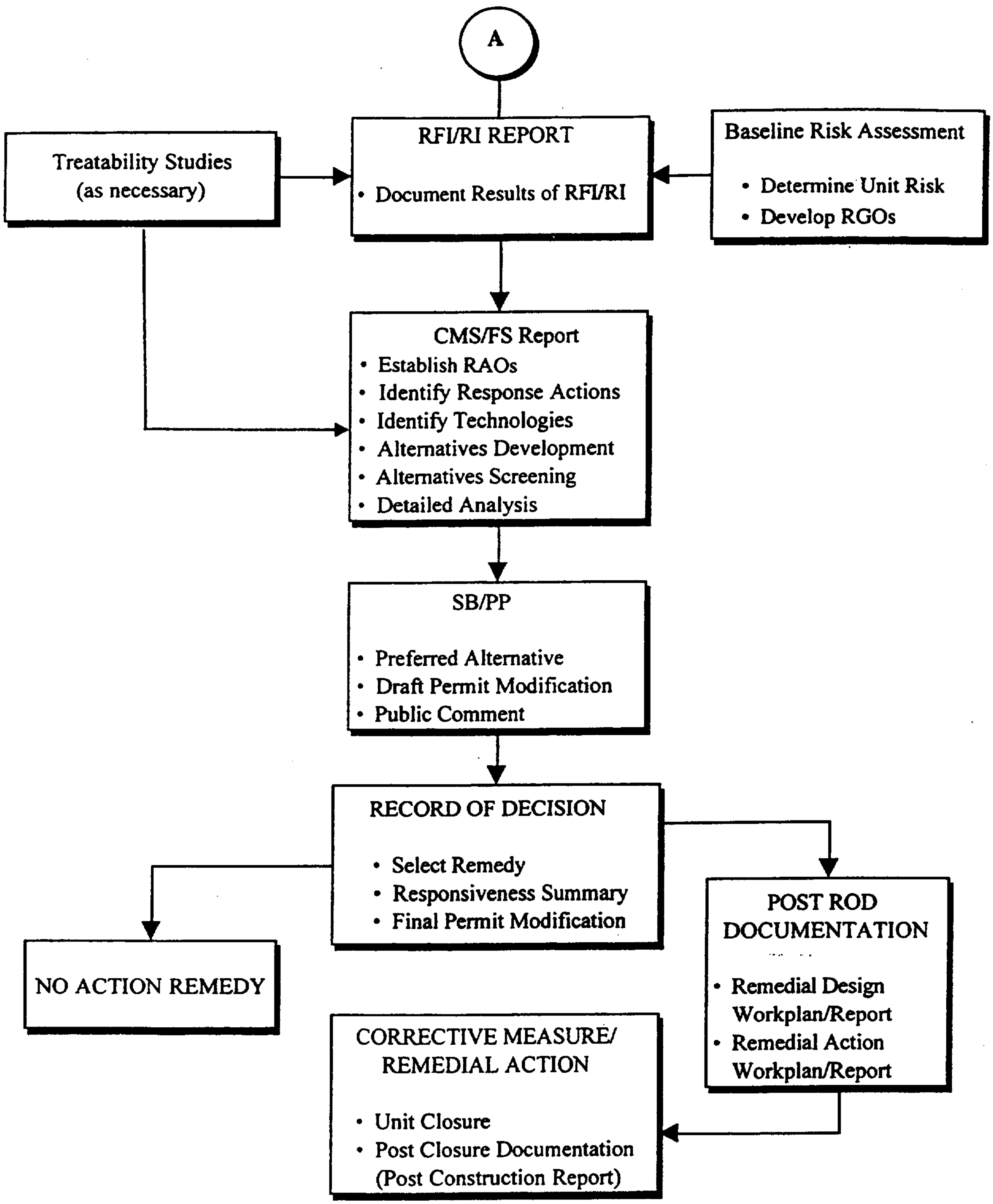

Figure 5. (continued) RCRA/CERCLA Logic and Documentation

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The SAFER method incorporates the DQO and OA processes to achieve the following:

- enhanced emphasis on *planning*
- linkage of data collection to *decision-making needs*
- explicit recognition and *management of uncertainty*
- direct and efficient *application of information gained* as planning and remediation proceed
- early convergence on a *remedy*
- informing and soliciting input from *key stakeholders (regulators and public)*

SAFER emphasizes the use of decision rules to quantitatively define data adequacy in the RFI/RI process. Each decision rule provides a quantitative statement defining what quantity and quality of data provide adequate information upon which decisions can be based. Inherent in the idea of the decision rule is the understanding that there will be uncertainty in the decision-making process. The goal is to identify data adequacy that provides acceptable uncertainty in making decisions while managing the residual uncertainty. The objective of the decision rule is to establish the linkage between the problem at the unit, its remedial objective, and data requirements. This will be done iteratively, first based on preliminary understanding and then modified as more information is obtained.

Federal, state, and local regulatory agencies are recognized as key stakeholders within the SAFER process. Continuing concurrence with regulatory requirements is an implicit SAFER objective. Data from previous environmental investigations, performed under the existing phased investigation approach, are included in the SAFER design. SAFER's iterative approach allows regulatory concurrence as the investigation proceeds. The SAFER process was implemented at the D-Area OSB as an Expedited Site Characterization (ESC) field effort that sought to accomplish project objectives in a rapid fashion while maintaining data quality.

The initial step in the SAFER process consists of identifying probable conditions at the investigation site and developing a conceptual site model (CSM) based on those conditions. This conceptual model is used to concentrate the unit investigation on the processes, medium(s), constituents, exposure pathways, and potential receptors most likely to be found during the investigation. With the model in mind, a more focused work plan can be developed to fully address each item identified in the model.

Section V provides the unit-specific CSM for the D-Area OSB OU and a summary of the characteristics of the primary and secondary sources and release mechanisms for the unit as determined in the RFI/RI.

Based on the CSM for the D-Area OSB, a detailed sampling and analysis plan was prepared and implemented (WSRC, 1995a, b; 1996a). The unit assessment plan and confirmation sampling plans were designed to characterize the following sources and release mechanisms:

- primary source: disposal trenches comprising the D-Area OSB
- primary release mechanisms: deposition and infiltration/percolation
- source media (primary media impacted): surface soil and subsurface soil
- secondary release mechanisms: fugitive dust generation, volatilization, vegetative (biotic) uptake, stormwater runoff, and leaching into the groundwater
- exposure media (secondary media impacted): air, produce, surface water, sediment, and groundwater

RFI/RI Characterization Report

The primary purpose of the RFI/RI is to establish unit-specific constituents (USCs) that pose potential risk through various exposure routes and to determine their distribution in the media associated with the unit. As an indicator of unit-specific contamination, the results of the analysis of soil, surface water, and sediment samples at the unit were compared to 2x mean background concentrations, and the groundwater analytical results were compared with EPA primary maximum contaminant levels (MCLs) or 2x mean background concentrations where no MCL exists. Compounds that exceed these comparison levels are called USCs and their nature and extent were evaluated in detail in the RFI/RI.

To address the identified sources and release mechanisms in the CSM, the following RFI/RI unit characterization objectives were identified for the D-Area OSB (WSRC, 1995a):

- enhance and refine the lithologic and hydrogeologic characterization of the subsurface in the vicinity of the D-Area OSB unit
- establish background concentrations of potential contaminants in soil, groundwater, surface water, and sediment to determine the impact on these media associated specifically with the operation of the D-Area OSB unit
- determine the USCs, if any, released to the various environmental media related to the D-Area OSB
- address aspects of the CSM related to sources, release mechanisms, and exposure media, and/or refine the CSM based on the data collected
- define the horizontal and vertical extent of contaminants in the impacted media
- assist in determining the feasibility of potential remedial alternatives through the collection of preliminary soil engineering parameters

- confirm groundwater analytical data generated by the onsite lab during the SAFER process, with analyses for USCs generated by a conventional, offsite laboratory data

BRA

The purpose of a BRA is to develop risk information to assist in the decision-making process for remedial sites (EPA, 1989b). This risk assessment follows the EPA Risk Assessment Guidance for Superfund (EPA, 1989b, c). According to EPA, 1989b, a BRA should provide the following:

- an analysis of baseline risks and help determine whether there is a need for remedial action
- a basis for determining levels of chemical and radiological constituents that can remain in-situ, on-unit and that will be adequately protective of human health and the environment
- a basis for comparing potential human health and ecological impacts of various remedial alternatives
- a consistent process for evaluating and documenting risk to public health and the environment

The BRA assesses risks that may result from a release of, and exposure to, chemical contaminants under reasonable maximum exposure (RME) conditions. The assessment uses current and hypothetical future land use scenarios and associated receptors with the assumption that constituent concentrations remain the same as reported in the RFI/RI. The RME represents the highest exposure that is reasonably expected to occur at the unit.

During the development of a BRA, risk from the unit is quantified, based on unit-specific data, for current and future human and ecological receptors, through the multiple exposure routes identified in the CSM. Carcinogenic risk at or above 1.0×10^{-6} (one excess human cancer in a population of one million) is considered significant. In addition, if the hazard index (HI) is greater than 1.0 for noncarcinogenic constituents, there is concern that adverse health effects can occur.

The information from the BRA supports identification of those areas where no further action or selected remedial actions are warranted. The BRA also provides the basis for deriving risk-based constituent levels that are protective of human health and environment [remedial goal options (RGOs)] for use in consideration of remedial alternatives. A summary of the results of the BRA for the D-Area OSB is presented in Section VI.

CMS/FS

The results of the RFI/RI Report and the BRA provide the basis for establishing unit-specific remedial action objectives (RAOs) in the CMS/FS. RAOs for the D-Area OSB were developed to address: unit-specific contaminants, media of concern, potential exposure pathways, and remediation goals. The RAOs were based on the nature and extent of contamination, threatened resources, human and environmental risk information, and the potential for human and environmental exposure. In addition, the preliminary remediation goals for the D-Area OSB were developed based upon applicable or relevant and appropriate requirements (ARARs) or other information from the RFI/RI Report and the BRA.

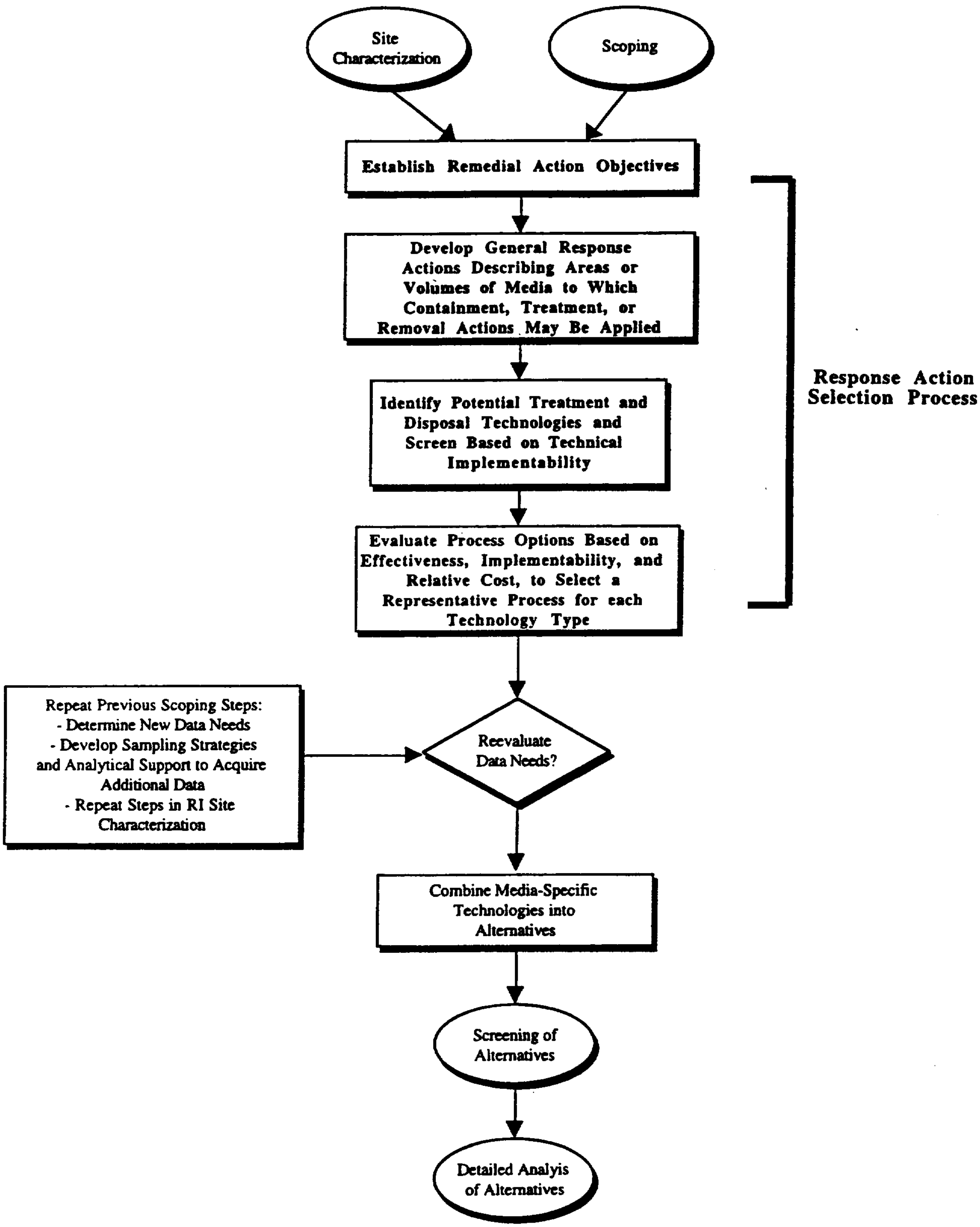
The methodologies used to identify and screen relevant technologies for the remediation of the waste unit followed an established remedy selection process developed by the EPA. The goal of this process is to select corrective measures/remedial actions that are protective of human health and the environment, that maintain protection over time, and that minimize contaminant (or waste) mobility, toxicity, or volume through treatment, when possible [CERCLA 300.430 (a)(1)(I)]. The selection of a response action for the D-Area waste unit proceeded in a series of steps, as defined in the National Oil and Hazardous Substances Contingency Plan (NCP) of November 20, 1985 (50 FR 47973), and as outlined in Figure 6. In addition, the remedial alternatives were further evaluated against the following nine selection criteria established by the NCP:

- overall protection of human health and the environment
- compliance with ARARs
- long-term effectiveness and permanence
- reduction of toxicity, mobility, or volume through treatment
- short-term effectiveness
- implementability
- cost
- state acceptance
- community acceptance

The results of the CMS/FS conducted for the D-Area OSB are summarized in Section VII, and a summary of the comparative analysis of the alternatives is provided in Section VIII.

SB/PP

The culmination of the response action selection process is the SB/PP. The purpose of the SB/PP is to facilitate public participation in the remedy selection process through the solicitation of public review and comment on all the remedial alternatives described. The SB/PP presents the lead agency's preliminary recommendation(s) concerning how best to undertake a remedial action at a particular waste unit. The SB/PP describes all remedial options that



Source: EPA, 1988a

Figure 6. Response Action Selection Process

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were considered in detail in the CMS/FS, and explicitly identifies both the preferred alternative for a remedial action at a waste unit and the preference rationale for that alternative.

The SB/PP directs the public to the RFI/RI, BRA, and CMS/FS reports as the primary sources of detailed, unit-specific information and information on the remedial alternatives analyzed. It also provides information on how the public can be involved in the remedy selection process. The public is notified of a public comment period through mailings of the *SRS Environmental Bulletin*, through notices in the *Aiken Standard*, the *Allendale Citizen Leader*, the *Barnwell People – Sentinel*, *The State*, and *Augusta Chronicle* newspapers, and through announcements on local radio stations.

ROD

The ROD documents the remedial action plan for a waste unit and consists of three basic components: a Declaration, a Decision Summary, a Responsiveness Summary. The purpose of the Declaration is to certify that the remedy selection process was carried out in accordance with the requirements of CERCLA and, to the extent practicable, the NCP. The Decision Summary is a technical and informational document that provides the public with a consolidated source of information about the history, characteristics, and risks posed by the unit, and includes a summary/evaluation of the cleanup alternatives and the considerations that led to the selected remedy. The Responsiveness Summary presents comments received during the public comment period on the SB/PP, and a response to each comment or criticism that was submitted in writing or orally. The Responsiveness Summary for the D-Area OSB is provided in Appendix A and an explanation of significant changes resulting from public comment on the SB/PP for the unit is provided in Section XI.

SRS received a RCRA hazardous waste permit from SCDHEC, which is renewed every five years. The D-Area OSB is a Solid Waste Management Unit (SWMU) listed on the SRS RCRA Permit because the unit received hazardous substances. Thus, the remedial decision for this SWMU requires a RCRA Permit Modification. No comments were received during the public comment period on the proposed remedial action and the associated draft RCRA permit modification (May 1 through June 14, 1998). This is indicated in the Responsiveness Summary of this ROD (Appendix A) and in the final RCRA Permit. The final RCRA Permit and this ROD document the final decision for this OU.

Post-ROD Documentation

The post-ROD documentation consists primarily of the design documents that are required prior to initiating a remedial action. Specific post-ROD documents include the combined Remedial Design Work Plan/ Remedial

Design Report/ and Remedial Action Work Plan (RDWP/RDR/RAWP) and the combined Post-Construction Report and Final Remediation Report (PCR/FRR). A discussion of the schedules that apply to these documents is provided in the SB/PP and in Section XIII of this ROD.

D-Area OSB Remedial Strategy

The RFI/RI process provides a method of managing the steps that lead to the ultimate remediation of a specific waste unit. An operable unit (OU) usually consists of the contaminated media (sources, soil, groundwater, sediments, surface water, and air) specific to a waste unit and the proposed actions related to their characterization and ultimate remediation, and/or the timing of those actions.

The overall strategy for addressing the D-Area OSB was to: (1) characterize the waste unit by delineating the nature and extent of contamination and identifying the media of concern (perform the RFI/RI); (2) perform a BRA to evaluate media of concern, constituents of concern (COCs), and exposure pathways, and to characterize potential risks; and (3) evaluate and perform a final action to remediate, as needed, the identified media of concern.

The D-Area OSB is an OU located within the Savannah River Floodplain Swamp watershed. Several OUs within this watershed will be evaluated to determine impacts, if any, to associated streams and wetlands. SRS will manage all OUs to minimize impact to the watershed. Based on characterization and BRA information, the D-Area OSB does not significantly impact the watershed. Upon disposition of all OUs within this watershed, a final, comprehensive evaluation of the watershed will be conducted to determine whether any additional actions are necessary. Based on the BRA and vadose zone modeling after the IRA and biovent testing, the soils at the unit do not warrant further remediation. Additionally, results of the BRA indicated that surface water and sediment at the unit do not require remediation. Groundwater is the only medium identified in the BRA that requires evaluation of remedial alternatives. The D-Area OSB investigation considered all unit-specific groundwater. Based on the investigation of the groundwater, the contamination in the water table aquifer is apparently attributable to the D-Area OSB wastes. The proposed action for the D-Area OSB groundwater, soil, sediment, and surface water is a final action.

V. OU CHARACTERISTICS

A CSM was developed for the D-Area OSB that identifies the primary source, primary contaminated media, migration pathways, exposure pathways, and potential receptors for the unit. The CSM for the D-Area OSB is presented in Figures 7a and 7b and is based on the data that are presented in the RCRA/CERCLA documentation for this unit. The data summary reports (WSRC, 1996b, c, d, e) and the combined *RCRA Facility Investigation/*

Remedial Investigation Report and Baseline Risk Assessment for the D-Area Oil Seepage Basin (WSRC, 1997a) contain detailed analytical data for all of the environmental media samples taken in the characterization of the D-Area OSB. These documents are available in the Administrative Record File (see Section III).

The primary data used for the RFI/RI and BRA were collected during the ESC Phase I, Phase II, confirmation phase (Phase III), Phase IV, and the post IRA soil sampling conducted during 1995 and 1996. All samples were analyzed in accordance with EPA-approved protocols.

As an indicator of unit-specific contamination, the soil, surface water, and sediment results were compared to 2x mean background concentrations, and the groundwater results were compared with EPA Primary MCLs or 2x mean background concentrations, where no MCL exists. Compounds which exceed these comparison levels are called USCs (Table 1) and their nature and extent are evaluated in detail in the RFI/RI and BRA Report.

For the analysis of the nature and extent of contamination, soil sample results were grouped into three depth intervals for both the unit and the background borings in conformance with the depth intervals evaluated in the BRA. These depth intervals are 0.0 to 0.3 m (0-1 ft), and 0.0 to 1.2 m (0-4 ft) which covered the exposures from surface soil and subsurface soil, respectively, as evaluated in the BRA. Analyses were also conducted on samples from a deep soil interval, extending below 1.2 m (4 ft) to evaluate the nature and extent of contamination in the deep soil for the unit. All groundwater samples collected and analyzed were taken from the uppermost aquifer and were evaluated as a single group. Additional physical and hydraulic analyses regarding the effects of the local weak aquitards on the movement of groundwater and contaminants were also conducted.

Primary Sources and Release Mechanisms

The primary source for the contamination of the various media is waste oils disposed in the D-Area OSB, a series of unlined trenches constructed to a depth of 1.2 to 3.7 m (4 to 12 ft) (Figure 3). These wastes were deposited directly into the deeper soil, greater than 1.2 m (4 ft) deep, and even into the local groundwater, when the water table was close to the surface. The waste oils disposed of in the D-Area OSB originated in D Area and other areas at SRS, and were disposed of in the D-Area OSB because they were unacceptable for incineration in the 400-D powerhouse boilers. The D-Area OSB has been out of service since 1975, when it was backfilled with soil.

The primary release mechanisms are deposition (contaminants deposited directly into the soils) and infiltration/percolation (contaminants migrating vertically and laterally into the pore spaces of the soils).

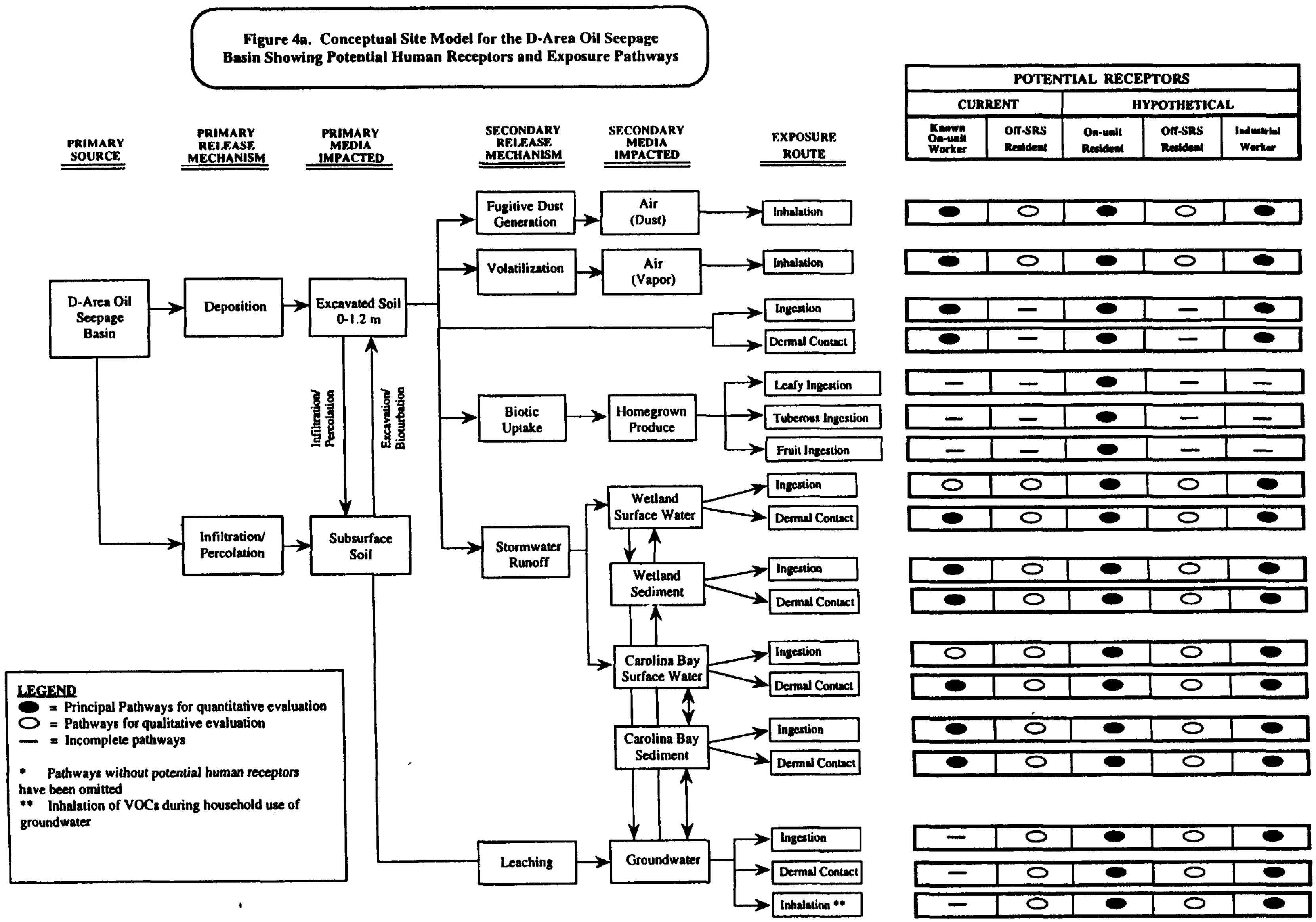
Secondary Sources and Release Mechanisms

Secondary source media impacted by waste disposal activities at the D-Area OSB include surface soils and subsurface soils within the basin and the basin perimeter. Secondary release mechanisms for surface soil include: fugitive dust generation, volatilization, biotic uptake, and stormwater runoff. Respective secondary media impacted for these release mechanisms are: air (dust), air (vapor), biota, and surface water. The secondary release mechanism for subsurface soil is leaching. The exposure medium for contaminants that leach from soil is groundwater, which may in turn discharge to and undergo potential chemical constituent exchange with biota, stream sediment, and surface water. A detailed sampling and analysis plan was prepared and implemented to investigate these secondary sources and a complete description of the sampling methods and protocols is provided in the RFI/RI Report and BRA (WSRC, 1997a).

Media sampled for investigation of this unit included soil (at multiple depths), groundwater (from the uppermost aquifer), surface water, and sediment (Carolina bay and the adjacent wetland).

Seventy-five compounds were detected at least once above screening levels in the soil, groundwater, surface water, and sediment associated with the D-Area OSB and have been designated as USCs, as listed on Table 1. Those compounds detected in soils were 23 metals, 15 volatile organic compounds (VOCs), 3 semi-volatile organic compounds (SVOCs), 11 pesticides/polychlorinated biphenyls (PCBs), and 5 ligands. The groundwater beneath the basin and as far downgradient as 320 m (1,050 ft) in the shallow aquifer contained USCs including 15 metals, 4 ligands, 16 VOCs, 4 SVOCs, 5 pesticides/PCBs, and total petroleum hydrocarbons (TPHs). Sediment and surface water in the Carolina bay and wetlands contained USCs comprised of 8 VOCs, 2 SVOCs, 4 pesticides/PCBs, 15 metals, 1 ligand, and diesel range organics (DROs) and TPHs.

A large fraction of the analytical results above detection limits for this report are estimated ("J"-flagged) values, with concentrations below the sample quantitation levels. The majority of sample results that exceed the quantitation level exceed it by less than an order of magnitude. Therefore, the data set for this investigation contains mainly low-level detections of compounds in both soil and groundwater.



Secondary Media Impacted	Exposure Route	Current: Known On-unit Worker	Current: Off-SRS Resident	Hypothetical: On-unit Resident	Hypothetical: Off-SRS Resident	Hypothetical: Industrial Worker
Air (Dust)	Inhalation	●	○	●	○	●
Air (Vapor)	Inhalation	●	○	●	○	●
Excavated Soil 0-1.2 m	Ingestion	●	—	●	—	●
Excavated Soil 0-1.2 m	Dermal Contact	●	—	●	—	●
Homegrown Produce	Leafy Ingestion	—	—	●	—	—
Homegrown Produce	Tuberous Ingestion	—	—	●	—	—
Homegrown Produce	Fruit Ingestion	—	—	●	—	—
Wetland Surface Water	Ingestion	○	○	●	○	●
Wetland Surface Water	Dermal Contact	●	○	●	○	●
Wetland Sediment	Ingestion	●	○	●	○	●
Wetland Sediment	Dermal Contact	●	○	●	○	●
Carolina Bay Surface Water	Ingestion	○	○	●	○	●
Carolina Bay Surface Water	Dermal Contact	●	○	●	○	●
Carolina Bay Sediment	Ingestion	●	○	●	○	●
Carolina Bay Sediment	Dermal Contact	●	○	●	○	●
Groundwater	Ingestion	—	○	●	○	●
Groundwater	Dermal Contact	—	○	●	○	●
Groundwater	Inhalation **	—	○	●	○	●

Figure 7a. CSM for the D-Area OSB Showing Potential Human Receptors and Exposure Pathways

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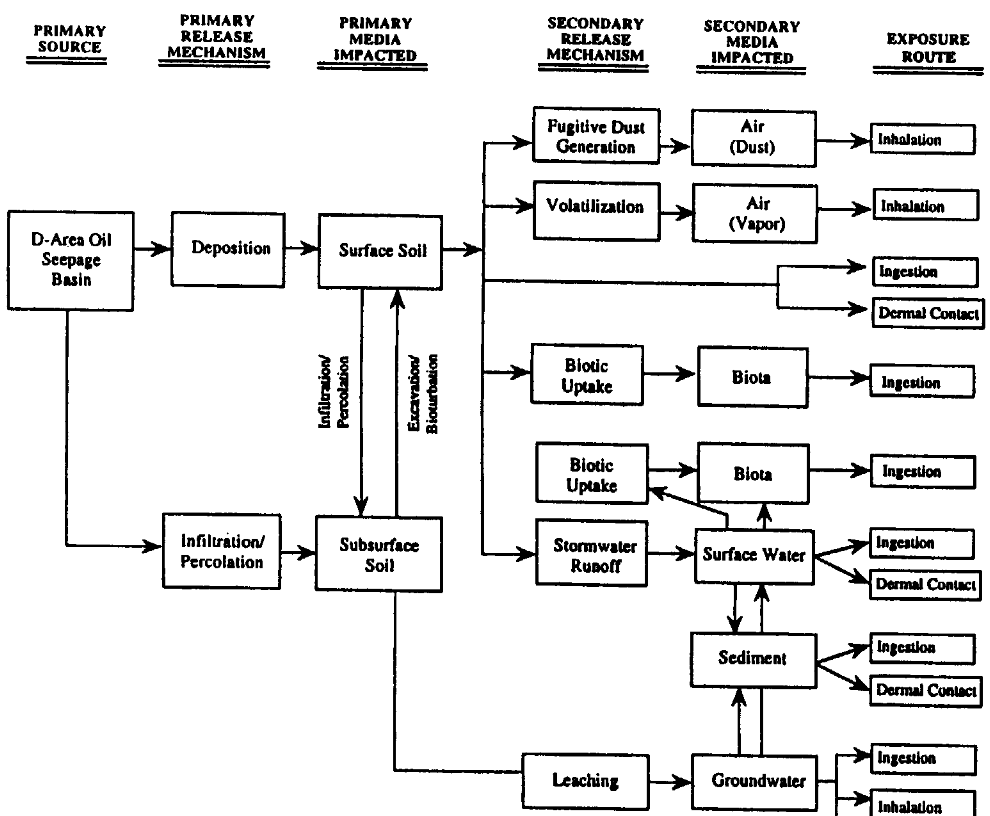
Figure 4b. Conceptual Site Model for the D-Area Oil Seepage Basin Showing Potential Ecological Receptors and Exposure Pathways



	POTENTIAL ECOLOGICAL RECEPTORS							
	CURRENT				FUTURE			
	TERRESTRIAL			AQUATIC	TERRESTRIAL			AQUATIC
Exposure Route	Basin	Carolina Bay	Wetland	Wetland	Basin	Carolina Bay	Wetland	Wetland
Inhalation (Air (Dust))	○	○	○	—	○	○	○	—
Inhalation (Air (Vapor))	○	○	○	—	○	○	○	—
Ingestion (Surface Soil)	●	●	—	—	●	●	—	—
Dermal Contact (Surface Soil)	○	○	—	—	○	○	—	—
Ingestion (Biota)	●	●	○	○	●	●	○	○
Ingestion (Biota)	○	○	●	●	○	○	●	●
Ingestion (Surface Water)	—	○	●	●	—	○	●	●
Dermal Contact (Surface Water)	—	○	○	○	—	○	○	○
Ingestion (Sediment)	—	—	●	●	—	—	●	●
Dermal Contact (Sediment)	—	—	○	○	—	—	○	○
Ingestion (Groundwater)	—	—	—	○	—	—	—	●
Inhalation (Groundwater)	—	—	—	—	—	—	—	—
Dermal Contact (Groundwater)	—	—	—	—	—	—	—	—

LEGEND
- ● = Principal Pathways for quantitative evaluation
- ○ = Pathways for qualitative evaluation
- — = Incomplete pathways

Figure 7b. CSM for the D-Area OSB Showing Potential Ecological Receptors and Exposure Pathways

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Table 1
USCs for all Media

	Surface Soil (Post IRA)	Subsurface Soil (Post IRA)	Deep Soil (Post IRA)	Ground-water (Pre IRA)	Surface Water (Pre IRA)	Sediment (Pre IRA)
Volatiles						
Acetone	6/14	11/28	13/30	31/75	5/5	
Benzene	2/14	5/28	9/30	2/79	1/5	
Bromomethane				2/79		
Butonone, 2-(MEK)	1/14	4/28	16/30	4/75		
Carbon Disulfide			5/30	9/75		
Carbon Tetrachloride				6/79		
Chlorobenzene	1/14	1/28	1/30	6/79		
Chloroethane				1/79		
Chloroform	1/14	1/28				
Dichloroethane, 1,1-				1/79		
Dichloroethene, 1,2 – (total)			5/30		5/5	
Dichloroethene, 1,2 – cis				2/218		
Ethylbenzene		1/28	12/30			
Methylene chloride (Dichloromethane)	14/14	28/28	26/30	1/79		
Styrene		1/28	1/30			7/8
Tetrachloroethene (PCE)	9/14	16/28		22/223	1/5	
Toluene			19/30			2/8
Trichloroethene (TCE)	4/14	7/28	5/30	35/223	4/5	
Trichlorofluoromethane				2/48		
Vinyl Chloride (Chloroethene)			1/30	24/223	2/5	
Xylenes		1/28	15/30			
Semivolatiles						
Bis(2-ethylhexyl) phthalate			2/30	3/26		
Benzoic acid	2/14	2/28				
Butylbenzylphthalate						2/8
Di-n-butyl phthalate			2/30	15/26	2/5	
Dichlorobenzene, 1,2-				1/26		
Dichlorobenzene, 1,4-				1/26		
Petroleum Indicators						
Diesel range organics						3/8
Total petroleum hydrocarbons (purgeable) (C4-C12)				1/14		2/8
Pesticides/PCBs						
Alpha-BHC	1/14	1/28	1/30	3/80		
Beta-BHC	1/14	1/28				
DDD, 4,4'-			1/30			1/8
DDE, 4,4'-	7/14	12/28	4/30			
DDT, 4,4'-	3/14	8/28	3/30			1/8
Delta-BHC			1/30	1/26		
Dieldrin		1/28	4/30			
Endosulfan I						1/8
Endrin	1/14	1/28	1/30	2/26		
Endrin ketone						1/8

(Table page 1 of 2)

Table 1 (continued)
USCs for all Media

	Surface Soil (Post IRA)	Subsurface Soil (Post IRA)	Deep Soil (Post IRA)	Ground-water (Pre IRA)	Surface Water (Pre IRA)	Se (P
Pesticides/PCBs (continued)						
Gamma-chlordane				1/80		
Heptachlor epoxide				1/26		
Lindane	1/14	1/28				
PCB-1254			1/30			
PCB-1260	3/14	5/28	4/30			
Metals						
Aluminum			1/30	13/29	2/5	
Antimony			5/30			
Arsenic		2/28	9/30			
Barium			12/30		1/5	
Beryllium			29/30	4/154		
Cadmium	5/14	12/28	10/30	3/154		
Calcium	2/14	6/28	30/30	15/29		
Chromium	6/14	13/28	2/30		2/5	
Cobalt			23/30	7/154	1/5	
Copper	6/14	12/28	13/30		1/5	
Iron	4/14	3/28		142/154		
Lead	7/14	22/28	13/30		3/5	
Magnesium	3/14	7/28	30/30	20/29		
Manganese			19/30	42/154		
Mercury	7/14	14/28	16/30			
Nickel	1/14	3/28	28/30	1/154	1/5	
Potassium		1/28	30/30	7/29		
Selenium	6/14	6/28	8/30			
Silver			3/30	15/154		
Sodium			22/30	8/29		
Thallium	3/14	5/28	2/30	1/29	2/5	
Vanadium	8/14	7/28		2/154	4/5	
Zinc	6/14	8/28	13/30	11/29	1/5	
Ligands						
Chemical oxygen demand				4/12		
Cyanide	1/14	3/28	7/30		2/5	
Nitrate as nitrogen	10/14	19/28	10/18			
Nitrogen by Kjeldahl method	14/14	28/28	18/18			
pH				3/12		
Sulfate	8/14	17/28	10/18			
Total organic carbon				4/4		
Total Organic Halogens				2/4		
Total phosphates (as P)	14/14	28/28	18/18	5/12		

Note: The numbers on this table reflect the number of samples exceeding the media-specific screening value over number of samples collected.

(Table page 2 of 2)

Soil

The analytical data indicate that there has been minimal impact to the surface and subsurface soil media [down to 1.2 m (4.0 ft)] from past disposal activity at the D-Area OSB. This conclusion is supported by the historical record for the unit. The trenches that received the waste oils and other debris were constructed to a depth of 1.2 to 3.7 m (4-12 ft), which resulted in waste placement beneath, rather than into, the shallower soils. The wastes were deposited onto the deeper soil, and even into the local groundwater when the water table was close to the surface. The greatest impact is to the deep >1.2 m (>4 ft) soils into which the waste was deposited.

The principal VOC constituents impacting soil quality at the basin are the chlorinated hydrocarbons [tetrachloroethene (PCE), trichloroethene (TCE), 1,2-dichloroethene (1,2-DCE), and vinyl chloride], which probably represent a degradation series starting with the PCE and TCE deposited in the basin with waste oils and grease (Table 1). The aromatic compounds benzene, toluene, ethylbenzene, and xylene (BTEX), which are commonly associated with petroleum products like gasoline, are also found in the vadose zone soils, but appear to be of secondary importance to the chlorinated hydrocarbons. Three other VOCs (acetone, 2-butanone, and methylene chloride) also appear to be related to waste disposal actions in the basin. The metals chromium, iron, lead, mercury and zinc are distributed throughout the D-Area OSB in a fashion similar to the VOCs and appear to have elevated concentrations within the soils of the trenches, primarily below the surface and subsurface soil horizons.

Groundwater

The principal contaminants found to exceed their respective screening levels in the groundwater (MCLs, where they have been established, and 2x mean background, where no MCL exists) are listed on Table 1 and include compounds from all 7 analyte groups, except dioxins/furans. The pattern developed from a review of the data set is generally consistent with a source of contaminants in the basin and with a plume in the groundwater migrating downgradient from the basin to the south and southwest in the uppermost aquifer.

Three chlorinated hydrocarbons (TCE, PCE, and vinyl chloride) were the most common VOCs detected and had the highest concentrations. The uppermost aquifer contaminant plume outlined by these compounds is at least 320 m (1,050 ft) long by 100 m (300 ft) wide and extends vertically from the water table surface down to at least 12 m (40 ft) in depth. The "green clay" occurs at 12 m (40 ft) bls and is expected to provide a barrier against deeper vertical migration of contaminants. The vertical geometry of the TCE plume is typical of dissolved organic compounds in an aquifer with an internal downward vertical gradient. The source area contains the highest concentrations and narrowest lateral extent with concentrations decreasing and the cross-sectional area increasing with distance from the source. In general, with the exception of a small portion of the aquifer in the immediate vicinity of the former trenches, VOCs in the groundwater were found at concentrations below 100 µg/l. A small area called the "hot spot", having an approximate diameter of 6 m (20 ft), contained the highest total concentrations of TCE (1,151 µg/l) detected during the investigation.

TCE was the compound detected most frequently above the screening levels (Figures 8 to 11). It was found from the water table aquifer down to the "green clay" (Figure 10). TCE was also the compound detected farthest downgradient [8.11 µg/l (micrograms per liter)] 215 m (700 ft) southwest of the basin. Concentrations detected in the samples ranged from non-detect up to 1,151 µg/l, with an average of 8.0 µg/l. These data indicate that this compound is present in groundwater in a volume approximately 365 m (1,200 ft) long by 100 m (300 ft) wide and from the water table surface to 12 m (40 ft) in depth.

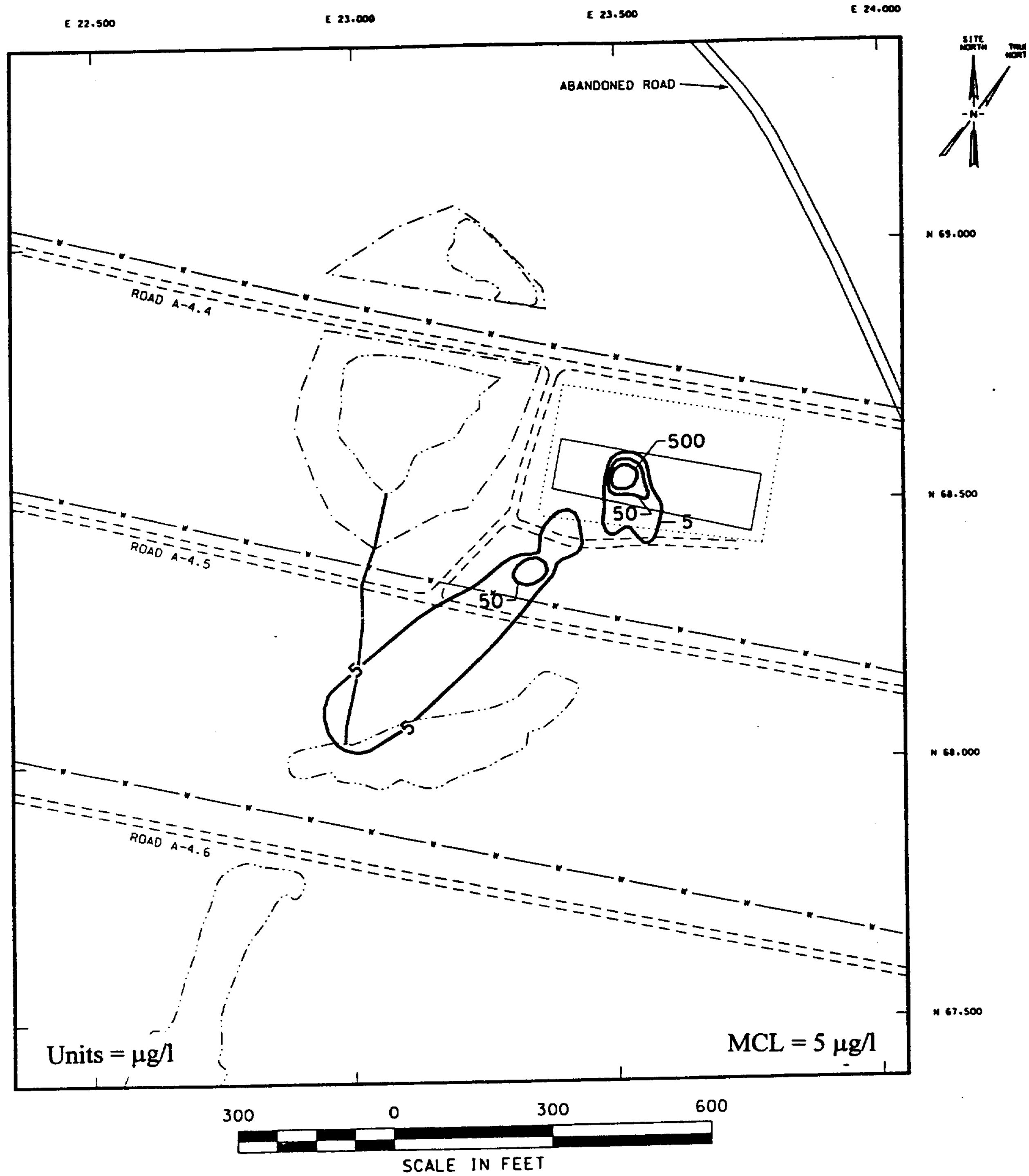
PCE was the second most frequently detected VOC at concentrations above screening levels. Concentrations of this compound ranged from below the detection limit up to 84.95 µg/l, with an average of 2.1 µg/l. The PCE plume is smaller than, and wholly contained within, the TCE plume.

The third most frequently detected VOC above its screening level was vinyl chloride. It was found throughout the same aquifer zones as the two preceding compounds and is a degradation product of them because it was never used at SRS. The concentrations of vinyl chloride ranged from below the detection limit up to 52.0 µg/l, with an average of 1.1 µg/l. Like the PCE plume, the vinyl chloride plume is contained within the TCE plume.

The isomers of DCE were the fourth most frequently detected VOC above screening levels. This compound can be found in groundwater over a volume approximately 260 m (850 ft) long by 100 m (300 ft) wide and from the surface to 12 m (40 ft) in depth. The lateral extent of this compound is the smallest of the four most commonly detected VOCs and lies within the TCE plume shown on Figures 8 to 10.

Benzene was detected in only 13 of 97 groundwater samples (16%), with concentrations ranging from non-detect to 6.2 µg/l. Only two of the analyses exceeded the primary MCL (5.0 µg/l). The distribution of this constituent is primarily localized in the shallow portion of the aquifer immediately beneath the basin.

The SVOCs detected in groundwater samples were primarily bis(2-ethylhexyl) phthalate and di-n-butyl phthalate. Because the concentrations of these compounds were lower in the vicinity of the basin, it appears that the detected SVOCs do not originate at the D-Area OSB, but may be a result of sampling or analytical bias. Only one of 14 groundwater samples analyzed for DROs/TPHs contained detectable concentrations, and this sample was from the western-most disturbed soil area. No dioxins/furans were detected in the 26 samples analyzed, and only 5 pesticides/PCBs were detected at concentrations above their MCLs.



See Figure 11 for Master Legend

Figure 8. TCE in the Shallow Portion of the Water Table Aquifer

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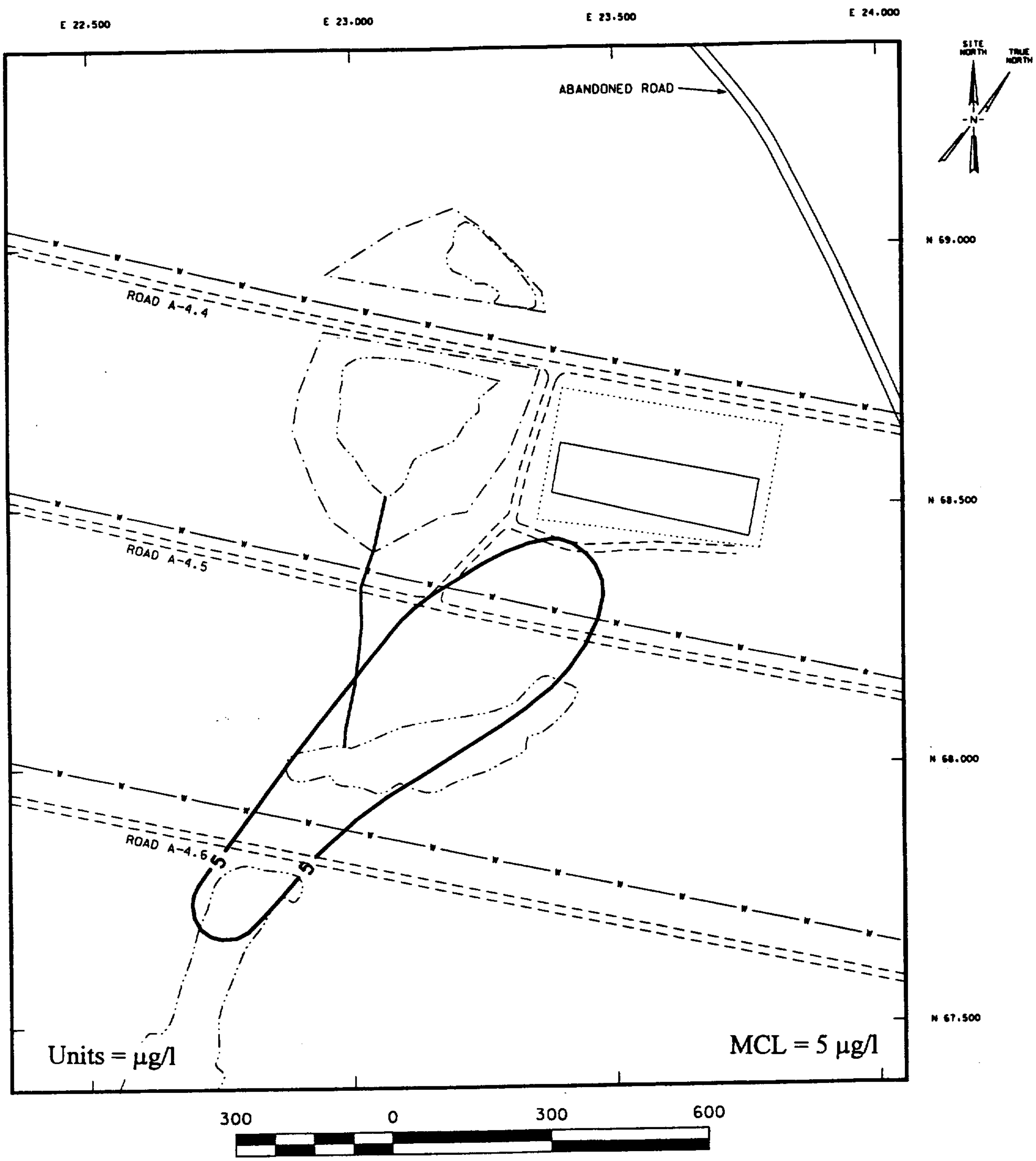

See Figure 11 for Master Legend

Figure 9. TCE in the Deeper Portion of the Water Table Aquifer

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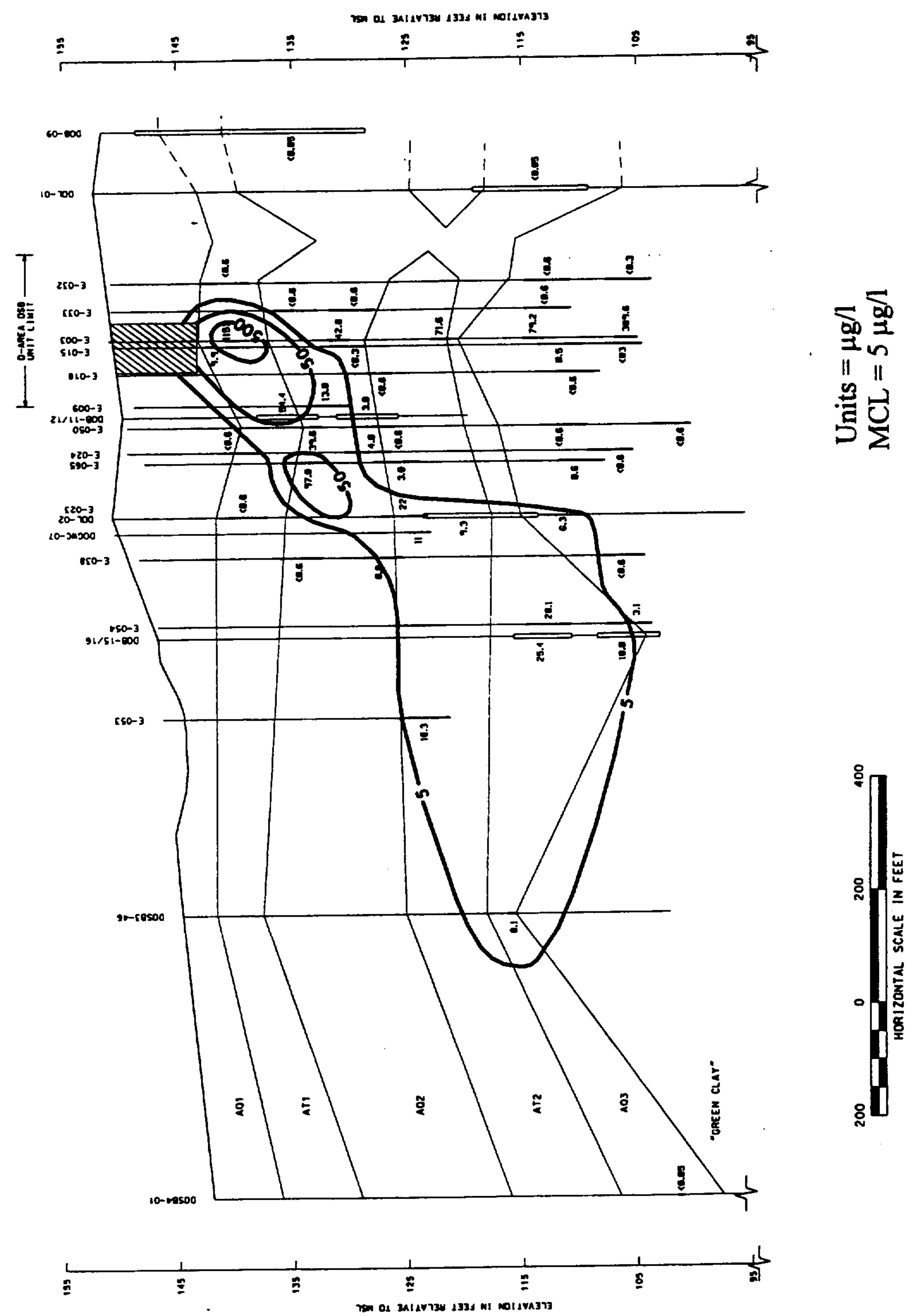

See Figure 11 for Master Legend

Figure 10. Cross Section of TCE in Groundwater

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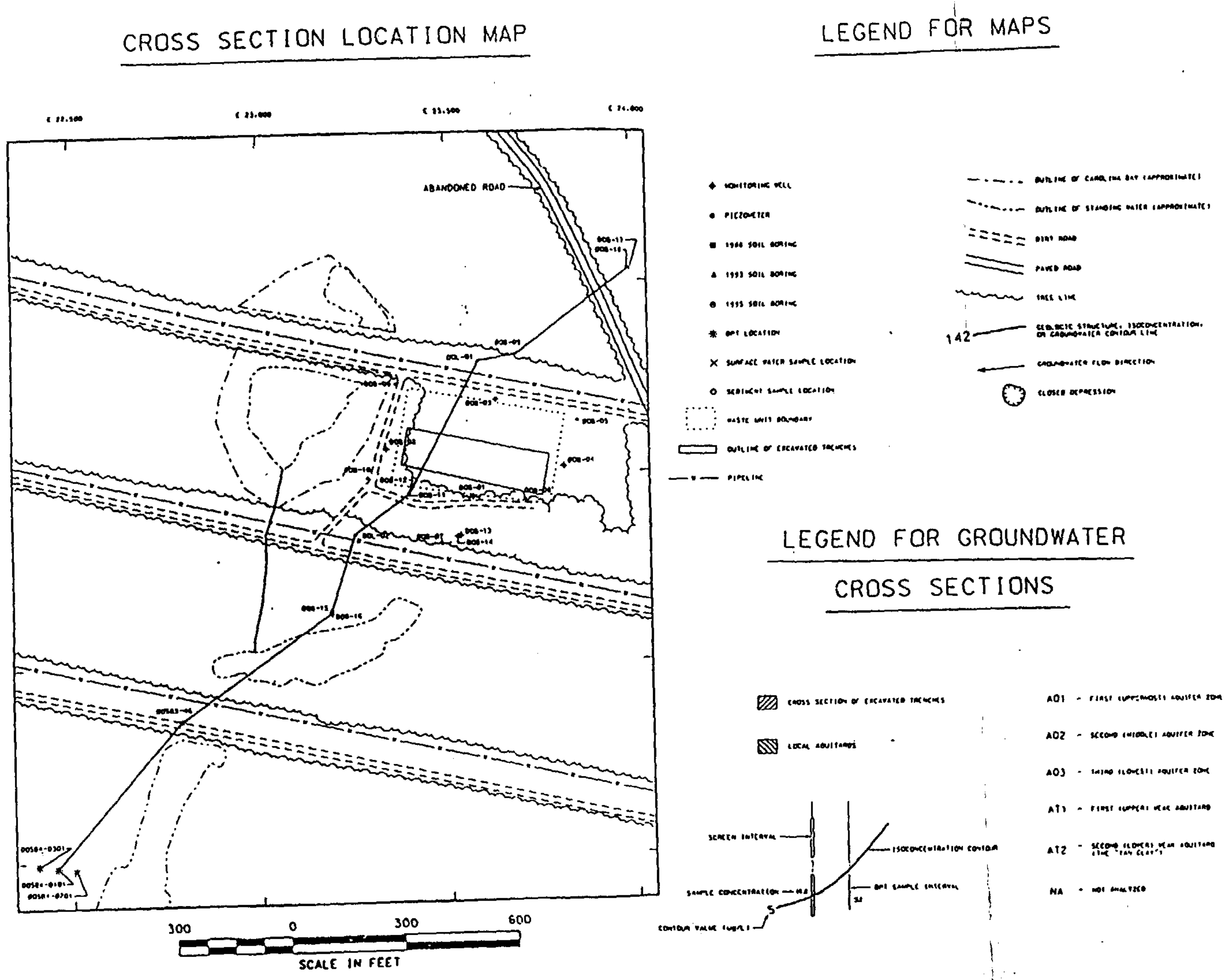
CROSS SECTION LOCATION MAP
ABANDONED ROAD
300
0
300
600
SCALE IN FEET
LEGEND FOR MAPS
MONITORING WELL
PIEZOMETER
WASTE UNIT BOUNDARY
OUTLINE OF EXCAVATED TRENCHES
PIPELINE
DIRT ROAD
PAVED ROAD
TREE LINE
142
CLOSED DEPRESSION
LEGEND FOR GROUNDWATER
CROSS SECTIONS
CROSS SECTION OF EXCAVATED TRENCHES
LOCAL AQUITARDS
SCREEN INTERVAL
ISOCONCENTRATION CONTOUR
SAMPLE CONCENTRATION
5
AO1
AO2
AO3
AT1
AT2
NA

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Groundwater samples were analyzed for metals and 22 were detected at least once at concentrations above their quantitation limits. Generally, the metal concentrations are low when compared with background and are within an order of magnitude of the screening levels. The exceptions are iron and manganese, which have their maximum concentrations (392,300 µg/l iron and 66,400 µg/l manganese) in the upper portion of the aquifer immediately below the former trenches. Elevated concentrations of these two metals continue to the southwest of the unit.

Surface Water

Surface water was sampled in the wetlands located downgradient of the D-Area OSB. Six VOCs, 1 SVOC, 10 metals, and cyanide were detected at very low or estimated ("J"-qualified) concentrations. The impact of the detected compounds is not significant when compared to background.

Sediment

Sediment at the unit was sampled from the Carolina bay to the west of the basin and from wetlands to the south. The concentrations of all detected compounds were estimated ("J"-qualifiers) or low when compared to background, and there were no apparent patterns to indicate the source for any of the detected constituents.

Fate and Transport Assessment

The conditions at the D-Area OSB appear to be favorable to the natural breakdown of the organic contaminants through the action of the in-situ bacterial population in the subsurface. Evidence of the degradation of contaminants in both the soil and groundwater are shown below:

SOIL	GROUNDWATER
• Elevated carbon dioxide and methane in soil gas	• depressed dissolved oxygen downgradient
• Depressed oxygen in soil gas	• Enhanced mobility of iron and manganese
• Location of the soil gas anomalies in close proximity to the most contaminated location	• Elevated chemical oxygen demand, chloride and sulfate levels downgradient
• Depressed pH levels in contaminated areas	• Depressed pH levels in contaminated areas
• Bacterial "slime" and noxious odors in one sample	• Presence of breakdown products (DCE and vinyl chloride)
• Presence of breakdown products (DCE and vinyl chloride)	

Soil Leachability Analysis

The soil data set was subjected to analysis by the soil screening level (SSL) process and Multimedia Environmental Pollutant Assessment System (MEPAS) computer model runs to evaluate the potential for constituents in the soil to migrate to the groundwater at levels exceeding their MCLs or risk-based concentrations (RBCs). Twenty-four constituents failed the SSL screening process (7 VOCs, 4 pesticides, and 13 metals) and were considered to be potentially leachable from the soil to the groundwater.

Following the SSL evaluation, two types of MEPAS computer simulations were conducted: a unit-wide evaluation for all 20 compounds and a "hot-spot" evaluation of the three constituents (antimony, methylene chloride (dichloromethane), and dieldrin) that failed the unit-wide test. All three of the remaining constituents failed the second series of "hot spot" runs, indicating that they have the potential to leach to the groundwater at concentrations exceeding the MCL or RBC, even after removing the sources from the most contaminated area of the trench.

After completion of the RFI/RI report, a supplemental calculation for a mass-limited SSL (MLSSL) was completed for methylene chloride. This supplemental calculation raised the target remediation concentration from 1.0 microgram per kilogram (µg/kg) (the SSL) to 41 µg/kg (the MLSSL). This is well below the maximum concentration in the RFI/RI (2,400 µg/kg) but exceeds the current (post-biovent test) sample results (4 µg/kg) by a factor of 10 (WSRC, 1997b, c). The biovent test cycle has been extremely effective in removing methylene chloride from the basin soils.

Groundwater Transport Analysis

The area in the vicinity of the D-Area OSB is currently listed as industrial future land use (DOE, 1996). Therefore, the potential for utilization of the shallow water table aquifer for potable water uses is minimal, and the only valid exposure scenario to unit groundwater is through the discharge of groundwater from the water table aquifer to the Savannah River or Fourmile Branch.

The estimated flow rates in the aquifer beneath the unit indicate that constituents in the groundwater could have traveled up to 2,350 m (7,700 ft) since the unit was opened in 1952, and up to 1,120 m (3,680 ft) since the basin was closed in 1975 (WSRC, 1997a). The fact that the largest plume in the groundwater (TCE) extends only 365.8 m (1,200 ft) from the source area (1/3 to 1/6 the distance predicted by groundwater flow) indicates that degradation, volatilization, retardation and other factors are working to reduce the impact of the basin disposal practices on the local groundwater.

VI. SUMMARY OF OU RISKS

As part of the D-Area OSB RFI/RI process, a BRA was prepared to evaluate the potential risk to human health and the environment from chemical contaminants identified in investigations at the D-Area OSB. The following sections outline the results of the human health risk characterization and the ecological risk characterization. A complete discussion of the risk assessment methodology, receptor analysis, risk characterizations, and uncertainty within the characterizations can be found in the RFI/RI Report and BRA (WSRC, 1997a).

Unit-specific data from the RFI/RI were used to identify and screen constituents of potential concern (COPCs). Exposure point concentrations were calculated and used to estimate potential exposures and risks to humans and wildlife. Carcinogenic risks and hazard indices (HIs), based on a combination of exposure scenarios, locations, and receptors identified in the CSM, were calculated and then compared to EPA risk guidelines [i.e., 1E-04 to 1E-06 carcinogenic risk, HI > 1, and Ecological Effects Quotient (EEQ) > 1]. COPCs were selected as preliminary COCs (PCOCs) and designated as primary or secondary COCs, based on their individual contribution to total media risk or hazard.

Human Health Risk Assessment

To evaluate the risk to human receptors due to the contamination at the D-Area OSB, unit-specific analytical data are used to identify COPCs. Exposure point concentrations are determined for each COPC to estimate the potential exposure for various receptors and exposure scenarios. Receptors were selected based on the current land use and two potential future land uses. Receptors include a current known on-unit worker (researchers and samplers), a hypothetical future on-unit industrial worker, and a hypothetical future on-unit resident (Figure 7a). Environmental media evaluated in the BRA include surface soil, excavated/subsurface soil, "hot spot" soil, surface water (wetland), sediment (wetland and Carolina bay), and groundwater (Figure 7b).

Following the selection of human receptors for evaluation, the cancer risk and the noncancer health hazard were estimated for each COPC and for each pathway/receptor combination, based on EPA guidance (EPA, 1989b).

Carcinogenic risk is defined as the incremental probability of an individual developing cancer over a lifetime as a result of pathway-specific exposure to cancer-causing contaminants (carcinogens). The risk to an individual resulting from exposure to non-radioactive chemical carcinogens is expressed as the increased probability of cancer occurring over the course of a 70-year lifetime. At NPL sites incremental cancer risk is compared to the EPA target risk range of one in ten thousand (1E-04) to one in one million (1E-06).

Noncarcinogenic hazards are also evaluated to identify a level at which there may be concern for potential noncarcinogenic health effects. The hazard quotient (HQ), which is the ratio of the exposure dose to the reference dose, is calculated for each contaminant. HQs are summed for each exposure pathway to determine the specific HI for each exposure scenario. If the HI exceeds unity (1.0), there is concern that adverse health hazards might exist.

Current Land Use – Carcinogenic Risks

Under the current land use scenario, human health risks were characterized for the current on-unit worker. Estimated cancer risks from surface soil ingestion, dermal contact, and particular inhalation were less than 1E-06, indicating no concern for carcinogenic health effects (Table 2).

Future Land Use – Carcinogenic Risks

The hypothetical future on-unit worker scenario has two exposure routes with carcinogenic risks within the target range of 1E-04 to 1E-06 (Table 2). Ingestion of excavated soil has a risk of 1E-06 primarily due to the ingestion of arsenic and PCB-1260, and ingestion of groundwater has an estimated risk of 5E-05 primarily due to the ingestion of beryllium, bis(2-ethylhexyl)phthalate, and vinyl chloride. The risks for the future worker from all other pathways are less than the EPA point of departure (1E-06).

Several pathways for the future on-unit resident have estimated risks within the target range (Table 2). Ingestion of surface soil and excavated soil have risk values of 1E-06 and 1E-05, respectively. The primary contributor to risk for ingestion of surface soil is PCB-1260. The primary contributors to risk for ingestion of excavated soil are arsenic and PCB-1260. Ingestion of leafy, tuberous, and fruit produce grown in excavated soil has estimated risk values of 2E-06, 1E-06, and 3E-06, respectively. The primary contributor to risk for all of these pathways is arsenic. Dermal contact (3E-06) with groundwater and inhalation of VOCs (1E-05) in groundwater during showering also have estimated risks between 1E-06 and 1E-04. The risk for hypothetical residential exposure to groundwater by ingestion (2E-04) is the only pathway to exceed the target risk range. Beryllium, bis(2-ethylhexyl) phthalate, and vinyl chloride are the primary contributors to the risks from ingestion and dermal contact, while groundwater inhalation risk is due to 1,1-DCE, cis-1,2-DCE, and vinyl chloride.

Current Land Use – Noncarcinogenic Hazards

The BRA shows that potential adverse noncarcinogenic health effects are not likely to occur because the sum of the HIs for the current on-unit worker scenario do not exceed a value of 1.0 (Table 2).

Future Land Use – Noncarcinogenic Hazards

Noncarcinogenic HIs for the hypothetical future on-unit worker do not exceed 1.0 for any of the pathways evaluated (Table 2).

Table 2

Summary of Risk-Based

PCOCs, Grouped by Exposure Route

Receptor *	Exposure Route/ Pathway	Preliminary COCs	Carcinogenic Risks	Hazard Index
Current Known On-Unit Worker	None	None		
Hypothetical Future Worker	Ingestion of Excavated Soil	PCB-1260, As	1.E-06	
	Ingestion of Groundwater	Be, BEHP, **Vinyl Chloride**	5.E-05	
Hypothetical Future Resident	Ingestion of Surface Soil	PCB-1260	1.E-06	
	Ingestion of Excavated Soil	PCB-1260, As	1.E-05	
		Fe, Tl, As		1.13
	Ingestion of Homegrown Produce Using Excavated Soil			
	Leafy vegetables	As	2E-06	
	Tuberous vegetables	As	1E-06	
	Fruits	As	3E-06	
	Ingestion of Groundwater	Be, BEHP, **Vinyl Chloride, 1,1-DCE, PCE**	2.E-04	
		Mn, Tl, Fe, BEHP, 1,2-DCE (mixture)		4
	Dermal Contact with Groundwater	Be, BEHP	3.E-06	
	Inhalation of Groundwater	**1,1-DCE, cis-1,2-DCE, Vinyl Chloride**	1.E-05	

* No Ecological Receptors were identified as being impacted by Unit-Specific Chemicals.

PCB = polychlorinated biphenyls
As = arsenic
Be = beryllium
BEHP = bis(2-ethylhexyl)phthalate
Fe = iron
BOLD = FINAL Risk-Based Constituents of Concern.
Tl = thallium
Mn = manganese
DCE = dichloroethene
PCE = tetrachloroethene

The HIs for hypothetical future resident exposures equal or exceed 1.0 for the ingestion of excavated soil and for the ingestion of groundwater (Table 2). The HI for ingestion of excavated soil is slightly greater than one and is primarily a result of thallium, iron, and arsenic concentrations. The HI for groundwater ingestion during childhood is 4 and the HI for groundwater ingestion during childhood through adulthood is 2. These hazards are due primarily to thallium and manganese.

Total Pathway Risks and Hazard Indices

Carcinogenic risks and noncarcinogenic hazards associated with the individual exposure pathways for surface soil (0-1 ft), excavated soil (0-4 ft), surface water, sediment and groundwater have been summed to obtain total pathway risks and HIs for each receptor (worker and resident). The total risk from surface soil (0-1 foot) and excavated soil (0-4 ft) were summed with the total risk from surface water, sediment, and groundwater for a total risk from all exposure pathways across all media for each receptor.

The total pathway risk values for the current known on-unit worker, hypothetical future on-unit worker, and hypothetical future on-unit resident are 6E-09, 5E-05, and 2E-04, respectively. The risk values that exceeded the EPA point of departure (1E-06) for the future receptors are a result of exposure to constituents in groundwater.

Total pathway HIs exceeded 1.0 for the future on-unit resident. These HIs were 5 [for pathways excluding excavated soil (0-4 ft)] and 6 [for pathways excluding surface soil (0-1 ft)]. The noncarcinogenic hazards for the future on-unit resident were a result of exposure to chemicals in groundwater and exposure to arsenic in excavated soil.

Ecological Risk Assessment (ERA)

The purpose of the ERA component of the BRA is to evaluate the likelihood that adverse ecological effects are occurring or may occur as a result of exposure of biological organisms to unit-specific chemical constituents. The specific methodology followed in the ERA for the D-Area OSB consists of a two-tiered evaluation. The first tier of the process is the selection of ecological COPCs through a screening evaluation. Any analytes that fail the screening are classified as COPCs and are evaluated in the second tier of the process, the ERA. The ERA is based on more unit-specific and realistic assumptions than the consistently conservative assumptions used in the screening. Accordingly, the ERA assesses whether COPCs, identified as having a potential to pose ecological risk in a very conservative screening, are actually likely to pose risk to assessment endpoints under existing or future conditions at the unit.

COPCs are identified following qualification and evaluation of data, and screening of inorganics against unit-specific background levels. Unit-specific soil was grouped into exposure groups in three exposure areas: (1) the area of the former basin, (2) the Carolina bay to the west, and (3) the wetland area to the south. Soil data from a depth of 0-0.3 m (0-1 ft) are used to estimate COPC exposure point concentrations under current land use conditions at the basin. Subsurface soil samples from a depth of 0-1.3 m (0-4 ft) are used to evaluate future risk, under the assumption of future excavation activity in the basin area associated with a hypothetical future human residential land use scenario. Groundwater data collected at the unit are evaluated under the future scenario by conservatively assuming that current groundwater concentrations of COPCs will discharge to surface water without attenuation or dilution. Sediment data from the Carolina bay and the wetland and surface water data from the wetland are assumed to remain unchanged under future conditions.

Exposure point concentrations for COPC selection are based on the maximum detected concentration for each exposure group. Exposure point concentrations for the ERA are based on the RME concentration, the highest concentration to which a receptor may reasonably be exposed. In selecting COPCs, those analytes that pass toxicity, background, and frequency of detection screenings but have an aquatic bioconcentration factor greater than 300 are re-included as COPCs due to their potential to pose risk through bioaccumulation and/or biomagnification.

The ecological study area at the D-Area OSB includes a variety of habitats, both terrestrial and wetland. No known endangered, threatened, or special concern species exist in the study area. The basin area has been highly impacted physically by previous activities at the unit, and the habitat (mowed field) is low in diversity and productivity. Areas adjacent to the unit include a mesic pine/hardwood forest, a Carolina bay wetland, and a blackgum/sweetgum wetland.

Following the identification of ecological COPCs and the characterization of the ecological communities of the study area, ecological assessment endpoints are selected so as to determine whether relevant policy goals (protection of the environment under CERCLA and protection of wetland surface waters under the Clean Water Act) are being attained at the OU. Ecological risk from unit-specific COPCs is assessed on the basis of the potential for adverse effects on the assessment endpoints: (1) survival and reproduction of terrestrial wildlife populations at the unit, including herbivores and predators; and (2) survival and reproduction of populations of aquatic species and of terrestrial wildlife species that prey on aquatic species in the wetland near the unit. Effects on assessment endpoints are predicted from measurement endpoints (e.g., levels of COPCs that have been shown to produce toxic effects in animal studies). Decision rules by which the potential for effects on assessment endpoints are decided are stated in terms of the measurement endpoints and are based on the calculation of HQs.

In order to evaluate potential effects on the assessment endpoints, multiple ecological receptor species are chosen to represent the multiple trophic levels of the ecological communities present within the study area. The receptors evaluated include: (1) aquatic organisms directly exposed to surface water and sediment; (2) a herbivorous rodent (meadow vole) directly exposed to soil, sediment, and surface water, as well as biotic uptake of COPCs; and (3) predators (mink and green-backed heron) that are directly exposed to environmental media as well as to bioaccumulative COPCs in the food chain.

Risks to each of these receptors from the exposure groups at the OU are estimated on the basis of calculated HQs. COPCs with an HQ greater than one are designated as PCOCs. Risk is estimated for both current conditions and hypothetical future conditions (i.e., assuming wildlife exposures to subsurface soil that may be excavated, and assuming exposure of aquatic organisms to current groundwater concentrations of COPCs). PCOCs are individually evaluated based on their chemical and toxicological characteristics and the uncertainty associated with their HQ value. Those PCOCs that are estimated to have a significant potential to cause adverse ecological effects are summarized for each combination of exposure area, receptor, and medium. This subset of COPCs is further evaluated based on uncertainty in the risk assessment, confidence in the risk estimates, and the ecological significance of the risk estimated to be posed by these PCOCs. This evaluation of ecological significance ultimately determines whether each PCOC actually poses significant ecological risk and warrants designation as a final COC.

The ecological receptors identified as having a significant potential for toxicological effects at the D-Area OSB are aquatic, semi-aquatic, and benthic organisms living in the Carolina bay and the wetland. The community of aquatic/semi-aquatic organisms that can be supported by the Carolina bay is inherently restricted in diversity and abundance of organisms due to the intermittent character of the inundation of the bay and its hydrological isolation. The ERA found that there may be significant potential for adverse effects from DRO on the more sensitive members of the aquatic community during chronic, long-term exposures. However, such exposures are unlikely due to the frequent dry periods during which the aquatic animal community is essentially absent. DRO at the concentrations detected in sediment is unlikely to significantly affect populations of aquatic species at the Carolina bay, therefore, the ecological risk posed by DRO is considered insignificant, and it is not a final COC.

The aquatic community in the arm of the wetland that extends to the south of the OU also is subject to intermittent desiccation, though it appears to be a more diverse and productive community than that of the Carolina bay. A potential for adverse ecological effects on this community is indicated by the measured concentrations of aluminum and barium in surface water and of DRO and TPH in sediment. Chronic exposure of aquatic organisms (e.g., invertebrates, fish, and amphibians) to these contaminants at RME levels could reduce reproduction and/or increase mortality among sensitive individuals sufficiently to cause a reduction in population size. However, if such effects are limited to the small area evaluated, the larger ecological community of the wetland system is unlikely to experience significant effects, such as a loss of species. Therefore, aluminum and barium in surface water and DRO and TPH in sediment of the wetland are unlikely to pose significant ecological risk to the wetland assessment endpoint (the biodiversity of the aquatic community), and they are not considered to be ecological final COCs.

In summary, the assessment of ecological risk at the D-Area OSB indicates that the COPCs and environmental media in the exposure areas evaluated do not pose significant risk to ecological assessment endpoints, and policy goals for the OU are achieved under baseline conditions. There is essentially no likelihood of unit-specific chemicals causing significant impacts to the community of species in the vicinity of the unit. Based on their toxicity at their current concentration, none of the COPCs identified in soil, sediment, or surface water at the D-Area OSB are estimated to pose significant ecological risk.

COCs

PCOCs, which include primary and secondary COCs, were selected for the D-Area OSB because they exceed ARARs, because they exceed risk-based criteria in the BRA, or because they are projected to have the potential to leach to the groundwater at levels exceeding an MCL or RBC. Primary COCs are defined in the human health risk assessment as constituents that contribute a chemical-specific risk of more than 1E-06 or an HQ of greater than 0.1 to any media risk estimate that exceeds a 1E-04 risk or an HI of 3. Secondary COCs are defined as those constituents in each medium contributing a chemical-specific risk greater than 1E-06 or an HQ of at least 0.1 to a media with a risk greater than 1E-06, but not more than 1E-04 or an HI of one or greater, but not more than three. Table 3 lists all PCOCs and the basis for their qualification as PCOCs.

The final risk-based COCs are presented by potential receptor scenario, pathway, and exposure route in Figures 12 through 16.

Final COCs were selected from the PCOCs by evaluating the uncertainty associated with each chemical during each phase of the RFI/RI/BRA (Table 4). Eight groundwater PCOCs [1,1-DCE; cis-1,2-DCE; total 1,2-DCE; benzene; dichloromethane (methylene chloride); PCE; TCE; and vinyl chloride] were judged to be USCs and, therefore, final COCs. One soil PCOC [dichloromethane (methylene chloride)] was judged to be a USC and, therefore, a final COC.

Table 3
Summary of PCOCs

PCOC Name	Basis	Risk or Hazard Value	Pathways
	PRIMARY GROUNDWATER COCs [1]		
1,1- Dichloroethene	exceeds risk criterion	2E-06	resident (childhood through adulthood) ingestion
		4E-06	resident (childhood through adulthood) inhalation
1,2-Dichloroethene (cis-)	exceeds MCL[3]		
1,2-Dichloroethene (mixed)	exceeds hazard criterion	0.27 / 0.49	resident (childhood through adulthood / childhood only) ingestion
Antimony	exceeds hazard criterion	0.1 / 0.26	resident (childhood through adulthood / childhood only) ingestion
Benzene	exceeds MCL[3]		
Beryllium	exceeds risk criterion	2E-04	resident (childhood through adulthood) ingestion
Bis(2-ethylhexyl)phthalate	exceeds risk criterion	1E-05	resident (childhood through adulthood) ingestion
	exceeds MCL[3]		
	exceeds hazard criterion	0.1 / 0.2	resident (childhood through adulthood / childhood only) ingestion
Dichloromethane	exceeds MCL[3]		
Iron	exceeds hazard criterion	0.3 / 0.6	resident (childhood through adulthood / childhood only) ingestion
Manganese	exceeds hazard criterion	0.4 / 0.77	resident (childhood through adulthood / childhood only) ingestion
Tetrachloroethene	exceeds risk criterion	2E-06	resident (childhood through adulthood) ingestion
	exceeds MCL[3]		
Thallium	exceeds hazard criterion	0.9 / 1.7	resident (childhood through adult / childhood only) ingestion
	exceeds MCL [3]		
Trichloroethene	exceeds MCL [3]		
Vinyl chloride	exceeds risk criterion	2E-05	resident (childhood through adulthood) ingestion
	exceeds MCL[3]		
	SECONDARY GROUNDWATER COCs [2]		
1,1-Dichloroethene	exceeds risk criterion	4E-06	resident (childhood through adulthood) inhalation
1,2-Dichloroethene (cis-)	exceeds risk criterion	4E-06	resident (childhood through adulthood) inhalation
Beryllium	exceeds risk criterion	4E-05	industrial worker ingestion
	exceeds risk criterion	1E-06	resident (childhood through adulthood) dermal contact
Bis(2-ethylhexyl)phthalate	exceeds risk criterion	3E-06	industrial worker ingestion
	exceeds risk criterion	1E-06	resident (childhood through adulthood) dermal contact
Vinyl chloride	exceeds risk criterion	5E-06	industrial worker ingestion
	exceeds risk criterion	4E-06	resident (childhood through adulthood) inhalation
	PRIMARY SOIL COCs [1]*		
Antimony	Projected to leach to groundwater in excess of MCL or RBC		
Dichloromethane	Projected to leach to groundwater in excess of MCL or RBC		
Dieldrin	Projected to leach to groundwater in excess of MCL or RBC		
Thallium	Projected to leach to groundwater in excess of MCL or RBC		
	SECONDARY SOIL COCs [2]*		
Arsenic	exceeds risk criterion	1E-06	industrial worker ingestion (soil 0-1.2 m)
	exceeds risk criterion	9E-06	resident ingestion and produce ingestion (0-1.2 m)
	exceeds hazard criterion	0.2	resident (childhood only) ingestion (soil 0-1.2 m)
Iron	exceeds hazard criterion	0.2	resident (childhood only) ingestion (soil 0-1.2 m)
PCB-1260	exceeds risk criterion	1E-06	resident (childhood through adulthood) ingestion (soil 0-0.3 m)
Thallium	exceeds hazard criterion	0.7	resident (childhood only) ingestion (soil 0-1.2 m)

1 Primary COCs are defined as COPCs which contribute significantly (chemical-specific risk of at least 1E-06 or chemical-specific hazard of 0.1) to a pathway having a total risk of greater than 1E-04 or HI greater than three, or which are projected to leach to groundwater at concentrations exceeding an MCL or RBC.

2 Secondary COCs are defined as COPCs that have a chemical-specific cancer risk greater than 1E-06, or a noncarcinogenic hazard of 0.1 which contributes to a pathway hazard greater than one.

* Soil COCs are developed from post-IRA (phase IV data), only. Pre-IRA data are not representative of current site conditions.

3 See Table 7-1 in WSRC, 1997a

Table 4

Uncertainty Matrix for COCs

Constituent Name	CATEGORY UNCERTAINTY LEVELS *								
	Unit History	Background Comparison	Analytical	Unit-Related Distribution	Toxicity	Risk Assessment	Exceeds ARAR?	Overall Level of Uncertainty	Retain as Final COC?
Groundwater COCs									
Antimony	high	LOW	high	high	high	high	high	high	no
Benzene	LOW	LOW	LOW	LOW	LOW	high	LOW	LOW	***YES***
Beryllium	high	high	LOW	high	LOW	LOW	high	high	no
Bis(2-ethylhexyl)phthalate	high	LOW	LOW	high	LOW	LOW	LOW	high	no
Dichloroethene, (cis-)1,2-	LOW	LOW	LOW	LOW	LOW	LOW	LOW	LOW	***YES***
Dichloroethene, (mixed-)1,2-	LOW	LOW	LOW	LOW	LOW	LOW	LOW	LOW	***YES***
Dichloroethene, 1,1-	LOW	LOW	LOW	LOW	high	LOW	LOW	LOW	***YES***
Dichloromethane (methylene chloride)	high	LOW	high	LOW	LOW	high	LOW	LOW	***YES***
Iron	high	LOW	LOW	LOW	high	high	high	high	no
Manganese	high	LOW	LOW	LOW	high	high	high	high	no
Tetrachloroethene	LOW	LOW	LOW	LOW	LOW	LOW	LOW	LOW	***YES***
Thallium	high	LOW	high	high	high	LOW	LOW	high	no
Trichloroethene	LOW	LOW	LOW	LOW	high	high	LOW	LOW	***YES***
Vinyl chloride	LOW	LOW	LOW	LOW	LOW	LOW	LOW	LOW	***YES***
Soil COCs									
Antimony	high	high	high	LOW	NA	NA	high	high	no
Arsenic	high	high	high	high	LOW	high	high	high	no
Dichloromethane (methylene chloride)	LOW	LOW	LOW	LOW	NA	NA	high	LOW	***YES***
Dieldrin	high	high	high	high	NA	NA	high	high	no
Iron	high	LOW	LOW	LOW	high	high	high	high	no
PCB-1260	unknown	LOW	LOW	high	high	high	high	high	no
Thallium	high	high	LOW	high	high	high	high	high	no

* Uncertainty = "LOW" indicates that this analyte could be a final COC based solely on the indicated category.
* Uncertainty = "high" indicates that this analyte could not be a final COC based solely on the indicated category.

NA = Category does not apply because this compound was added to this list based on its potential to leach to groundwater.

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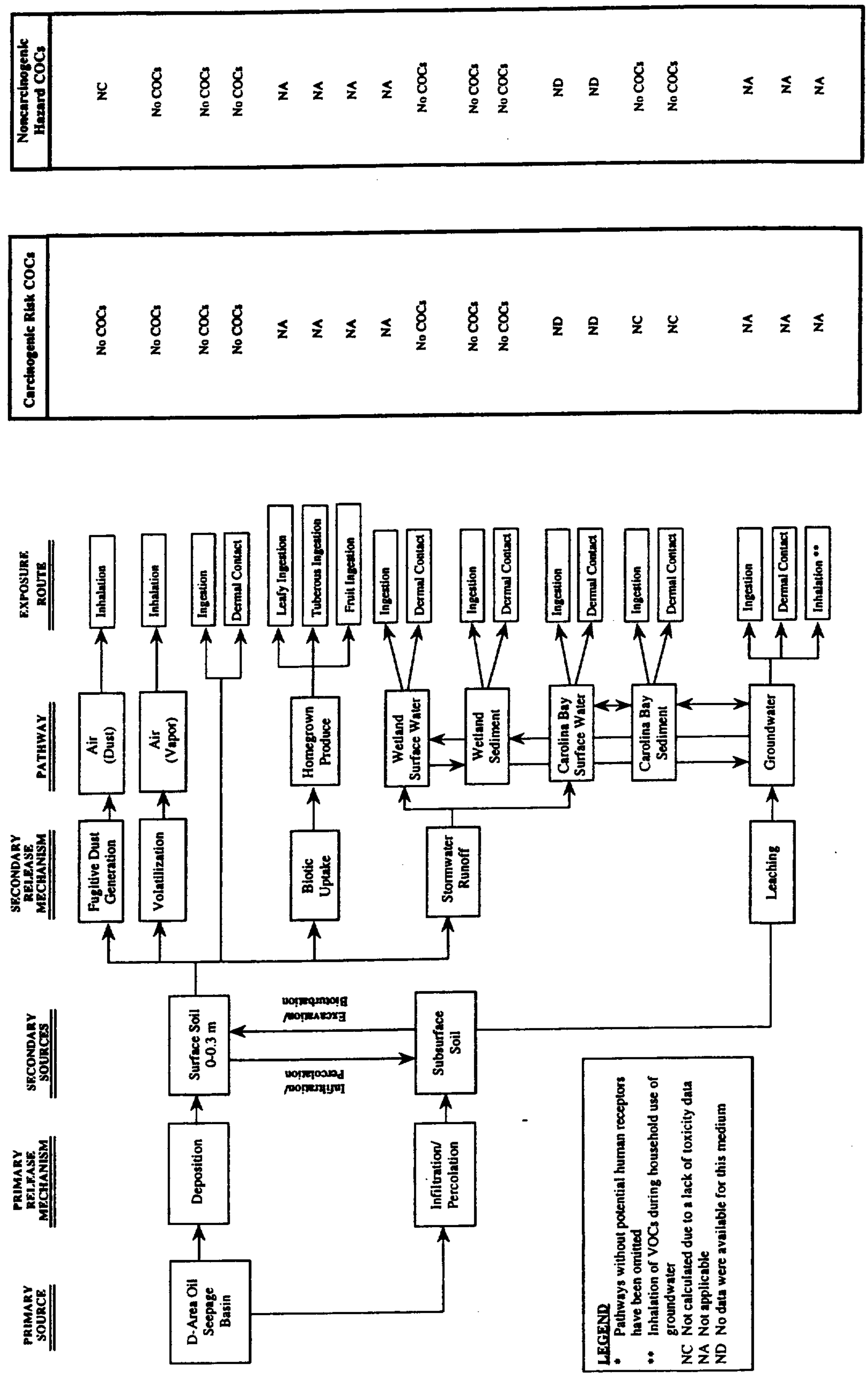

Figure 12. Risk-based COCs for the Current On-Unit Worker, by Pathway, after the Uncertainty Analysis

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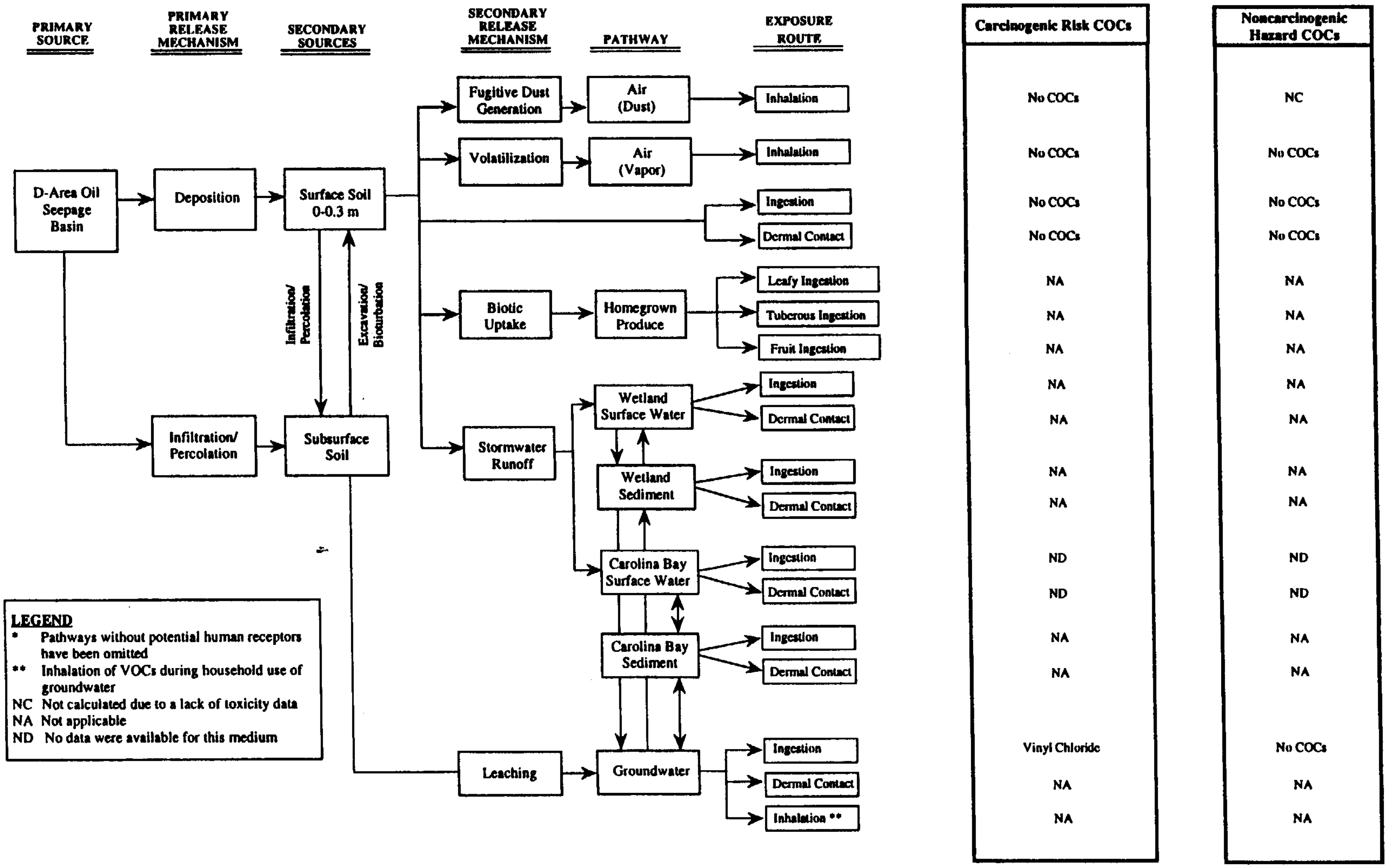

Figure 13. Risk-based COCs for the Future On-Unit Worker, without Excavation of Soils, by Pathway, after the Uncertainty Analysis

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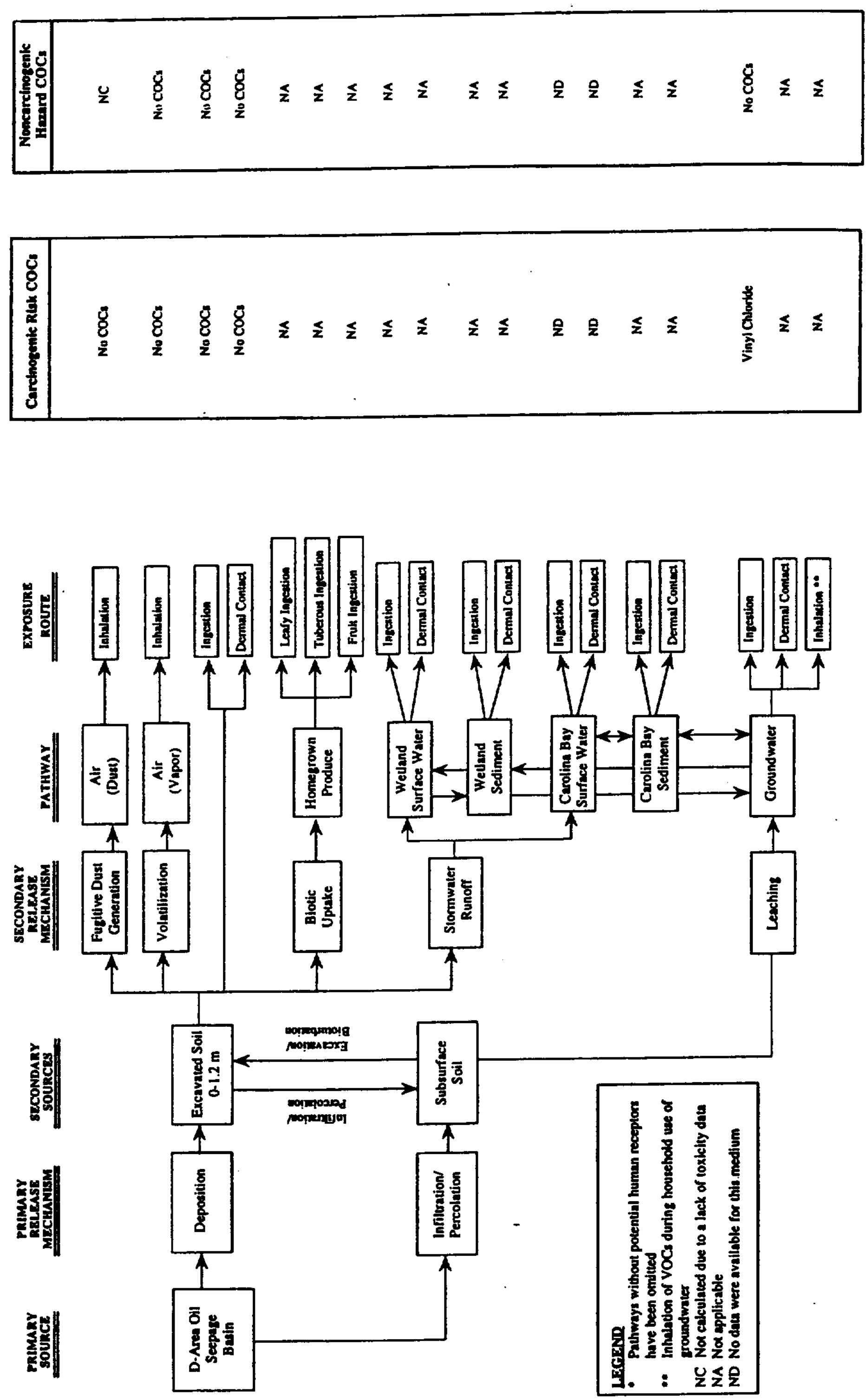

Figure 14. Risk-based COCs for the Future On-Unit Worker, with Excavation of Soils, by Pathway, after the Uncertainty Analysis

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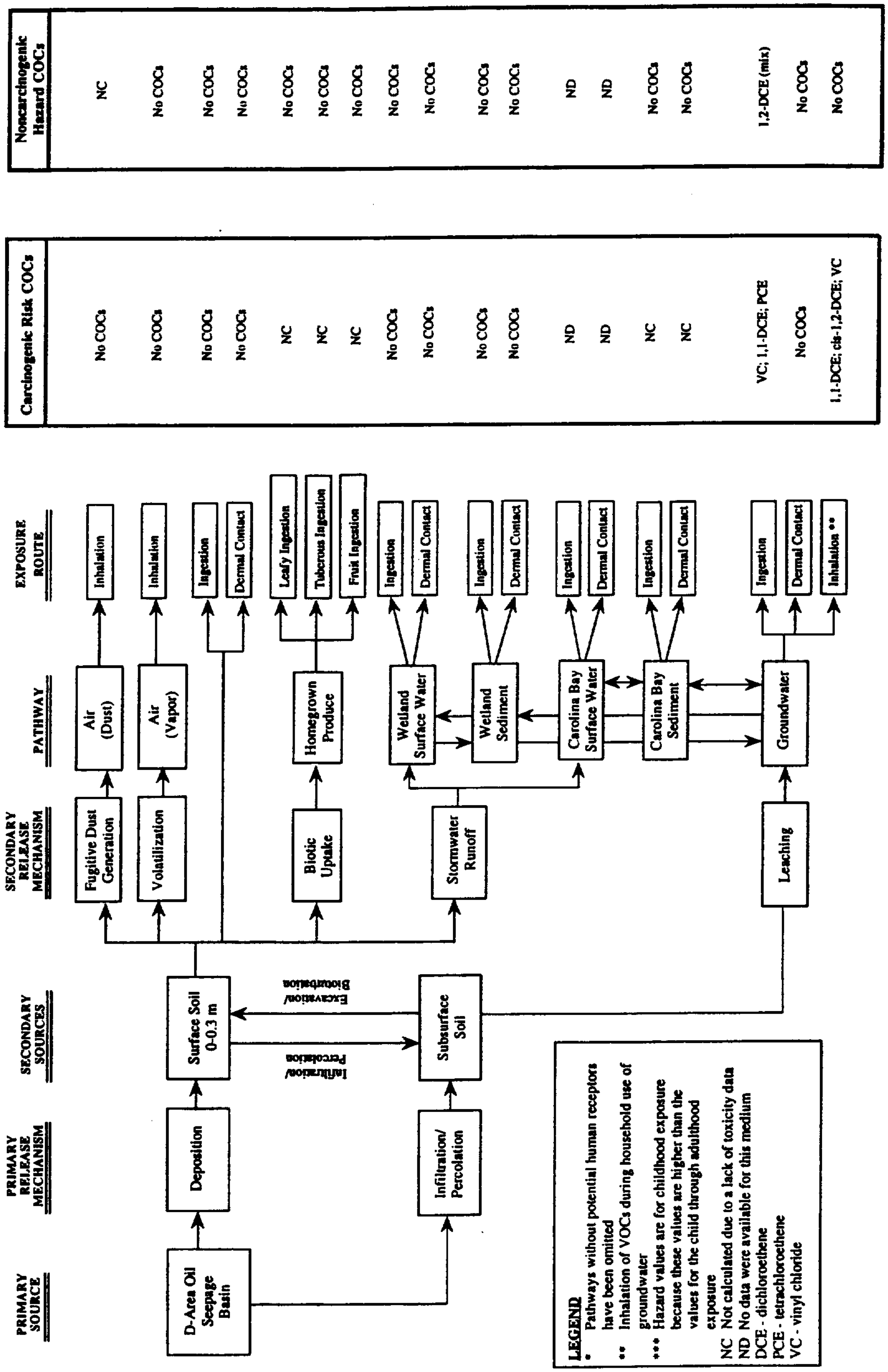

Figure 15. Risk-based COCs for the Future Resident, without Excavation of Soils, by Pathway, after the Uncertainty Analysis

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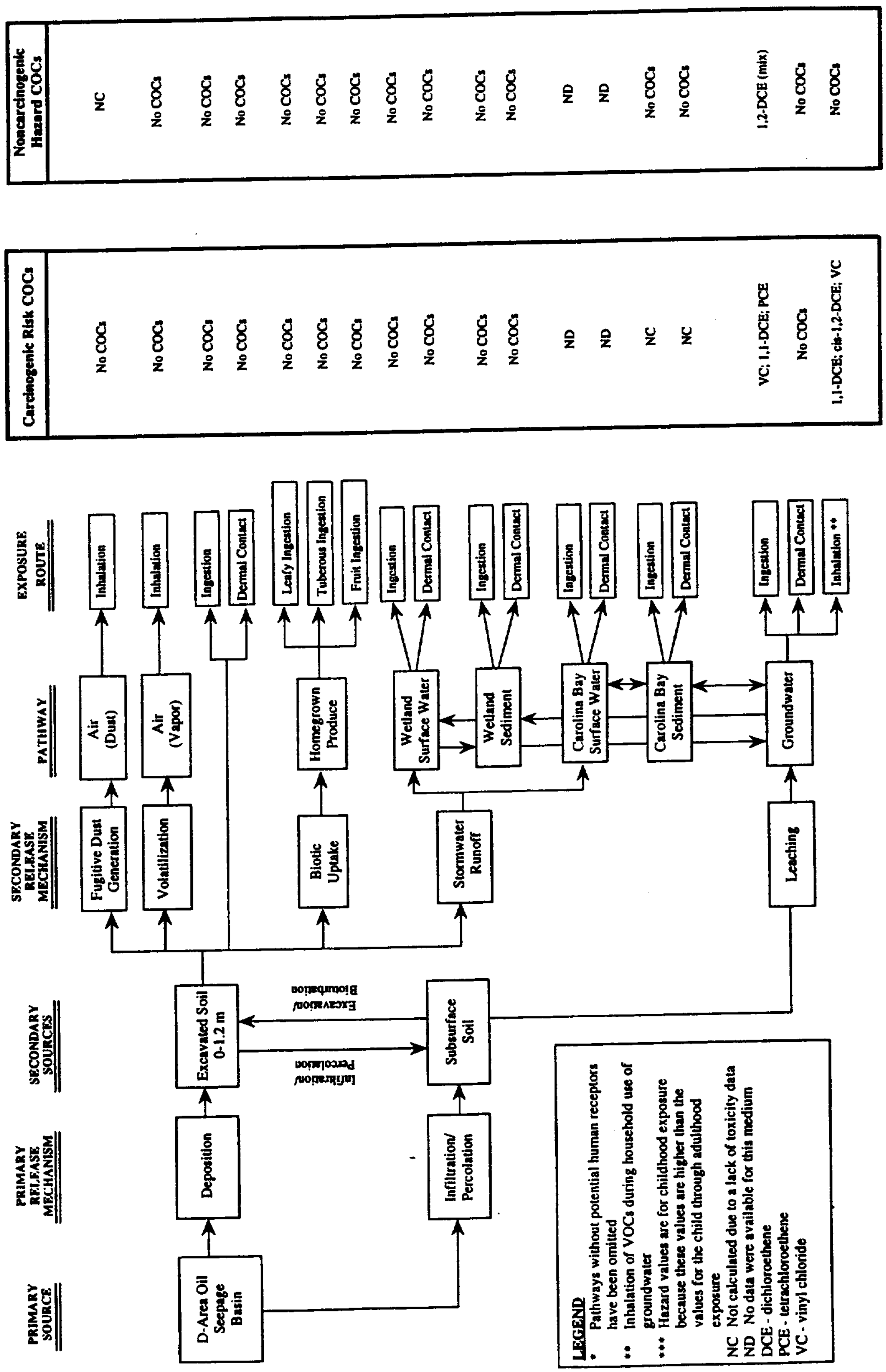

Figure 16. Risk-based COCs for the Future Resident, with Excavation of Soils, by Pathway, after the Uncertainty Analysis

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VII. RAOS AND DESCRIPTION OF CONSIDERED ALTERNATIVES FOR THE D-AREA OSB OU

RAOs

RAOs address unit-specific contaminants, media of concern, potential exposure pathways, and remediation goals. The RAOs are based on the nature and extent of contamination, threatened resources, and the potential for human and environmental exposure. Initially, preliminary remediation goals are developed based upon ARARs or other information from the RFI/RI Report and BRA. These goals should be modified, as necessary, as more information concerning the unit and potential remedial technologies becomes available. Final remediation goals will be determined when the remedy is selected and shall establish acceptable exposure levels protective of human health and the environment.

ARARs are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal, state, or local environmental law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site. The following three types of ARARs have been developed to simplify identification and compliance with environmental requirements:

- Action-specific requirements – set controls on the design, performance, and other aspects of implementation of specific remedial activities.
- Chemical-specific requirements – are media-specific and health-based concentration limits developed for site-specific levels of constituents in specific media. There are two general sources of chemical-specific RGOs: (1) concentrations based on ARARs, and (2) concentrations based on risk.
- Location-specific requirements must consider federal, state, and local requirements that reflect the physiographical and environmental characteristics of the unit or the immediate area.

Action-specific and location-specific ARARs are addressed as part of the remedial alternatives developed for the D-Area OSB groundwater. Only MCLs (as identified in South Carolina R.61-58.5 State Primary Drinking Water Regulations and Federal 40 Code of Federal Regulations (CFR) 141 National Primary Drinking Water Regulations) have been identified as chemical-specific ARARs. The groundwater is not a current source of drinking water; however, all groundwater in South Carolina is classified as GB under South Carolina R.61-68 Water Classification and Standards and, as such, is required to be addressed in some manner (State of South Carolina groundwaters must undergo active remediation to achieve MCLs unless a groundwater mixing zone (GWMZ) is granted). MCLs will be the clean-up standard for groundwater contaminants.

The RFI/RI and BRA identified the following COCs for groundwater at the D-Area OSB: PCE; TCE; 1,1-DCE; 1,2-DCE; cis-1,2-DCE; vinyl chloride; benzene; and methylene chloride.

Two of these contaminants (1,1-DCE and 1,2-DCE) became COCs based on risk calculations. However, neither 1,1-DCE nor 1,2-DCE were detected in the D-Area OSB groundwater at concentrations exceeding their respective MCLs. MCLs are drinking water standards developed to be protective of human health and obtainable by current treatment methods. Because these contaminants do not exceed the levels determined to be protective of human health and safe for drinking water purposes, 1,1-DCE and 1,2-DCE will not be addressed in D-Area OSB groundwater remediation. However, the remedial alternatives developed for the D-Area OSB groundwater include groundwater monitoring of VOCs (with the exception of no action) that will be inclusive of 1,1-DCE and 1,2-DCE. These VOCs are degradation products of TCE and require evaluation during remediation.

The primary chemical-specific ARAR for soil is an EPA SSL for methylene chloride (EPA, 1994). The screening level limits the concentration of methylene chloride in soil to 1.0 μg/kg based on its potential to leach to groundwater. A second screening level, the MLSSL (EPA, 1996), has been calculated to be 41 μg/kg based on unit specific conditions. Following biovent testing, methylene chloride concentrations were below the MLSSL of 41 μg/kg. Therefore, because methylene chloride concentrations in the soil have been reduced to levels that cannot leach to the groundwater above the MCL (WSRC, 1998a) remediation of deep soils is not warranted and it is not addressed further in this document.

Based on ARARs and BRA results, the RAOs developed for the groundwater at the D-Area OSB OU are to:

- reduce risks to human health associated with dermal contact and ingestion of groundwater, and inhalation of groundwater vapor
- restore groundwater to achieve ARARs and RGOs

RGOs for groundwater COCs will be equivalent to their respective MCL values. The groundwater contaminants that will be addressed at the D-Area OSB and their corresponding MCLs are provided in Table 5.

At the close of the IRA, the contractor installed two horizontally oriented, perforated pipes along the length of the former waste unit for treatability (biovent) study purposes. These pipes were used to force fresh air, nutrients and tracers into the soils at a depth of about 8 ft in order to volatilize the constituents in the soil, enhance the aerobic degradation of the constituents in both the soil and groundwater, and monitor the effectiveness of a potential soil treatment program (WSRC, 1997b, c, d, e).

Table 5

Final COCs, with Selected RGOs

FINAL COCs	Basis for Becoming Final COC				Maximum Concentration Detected (µg/l)	Average Concentration in Groundwater	Selected RGO (µg/l)	Basis for RGO
	Excess Risk	Excess Hazard	Leach to GW	Exceeds MCL				
Tetrachloroethene	X			X	85	2.1	5.0	MCL
Trichloroethene				X	1151	8.0	5.0	MCL
cis-1,2-Dichloroethene				X	457	4.88	70.0	MCL
total-1,2-Dichloroethene	X	X			68.6	21.24	70.0	MCL
1,1-Dichloroethene	X				0.84	0.399	7.0	MCL
Vinyl Chloride	X			X	52	1.1	2.0	MCL
Benzene				X	6.2	0.22	5.0	MCL
Dichloromethane (Methylene Chloride)			X	X	9.5	0.16	5.0	MCL

Secondary Source Alternatives

As part of the investigation/assessment process for the D-Area OSB waste unit, a CMS/FS was performed using data generated during the assessment phase. Detailed information regarding the development and evaluation of remedial alternatives can be found in the *Corrective Measures Study/Feasibility Study for the D-Area Oil Seepage Basin (631-G) (U)* (WSRC, 1998a). The RFI/RI and BRA indicate that D-Area OSB groundwater poses a risk to human health. Risk associated with ingestion, dermal contact, and inhalation of groundwater for the future on-unit worker and resident result in risk greater than the EPA's target risk range for future use scenarios. Therefore, a CMS/FS was conducted, which includes detailed analyses and groundwater alternatives. Concerning other environmental media, the no further action alternative was selected for soil, and no action is required for surface water and sediment.

Remedial alternatives were not developed for soil, surface water, or sediment at the unit. Remediation of these media is not warranted based on the evaluation of federal and state standards and the risk assessment. As discussed above, the interim action and the biovent test cycle performed on unit soil adequately eliminated the source of groundwater contamination. Six alternatives were evaluated for remedial action of the D-Area OSB OU groundwater. Each alternative is described below.

Alternative GW-1 - No Action

Under this alternative, no remedial efforts would be conducted to remove, treat, or otherwise reduce the toxicity, mobility, or affected volume of contaminated media. An IRA and biovent test have been conducted for unit soils. These reduced contaminant concentrations to acceptable levels. Biovent testing appears to have also reduced groundwater contaminant concentrations in the vicinity of the testing. However, under the no-action alternative, no further remedial efforts would be made to monitor or treat unit groundwater.

The semi-confining unit ("tan clay") lying within the uppermost, water table aquifer is not continuous and has not prevented contaminant migration. However, the next confining layer ("green clay") provides an adequate barrier, which prevents the migration of COCs to lower aquifers (Figure 10). Additionally, modeling results indicate that under most scenarios, contaminant plumes have already largely reached their maximum extent downgradient and will not migrate significantly further. Therefore, both the horizontal and vertical migration of contaminants appears to have largely stopped. However, the no-action alternative would not provide a mechanism to monitor the migration of contaminants in the future and confirm that further migration is not occurring. Additionally, the no-action alternative would not guarantee that access to contaminated groundwater would be restricted.

If no action were implemented, no action would be taken to reduce or monitor contaminant concentrations. Transport modeling of the D-Area OSB DCE, PCE, TCE, and vinyl chloride contaminant plumes indicates that without degradation concentrations would be reduced to below MCLs within 35 years. (Model runs that included degradation indicated that the maximum time required for contaminants to reach their MCLs was only approximately 10 years.) For the purpose of cost estimating, the maximum length of time to be evaluated is 30 years, as determined by EPA guidance. Therefore, the cost of this alternative would include a review of remedy every five years for 30 years and would total $278,000.

Alternative GW-2 - Natural Attenuation/GWMZ with Institutional Controls

Under this alternative, natural subsurface processes, such as flushing, volatilization, biodegradation, adsorption, and chemical reaction with subsurface materials, would be allowed to continue to reduce contaminant concentrations in the groundwater to acceptable levels. A GWMZ application has been approved by the SCDHEC under South Carolina Regulations R.61-68 as part of this alternative. This GWMZ creates a specific area at the unit that would be required to meet mixing zone concentration limits (MZCLs) at plume monitoring wells. Downgradient compliance boundary wells would be installed. Groundwater at this compliance boundary would be required to meet RGOs (equivalent to MCLs). Between the compliance boundary wells and the plume wells, intermediate wells will be monitored and compared to concentrations predicted by the fate and transport models. The well locations for the approved GWMZ are illustrated in Figure 17. In addition to groundwater monitoring, institutional controls will be maintained to restrict access to groundwater until RGOs are met in all areas of the plume. Institutional controls would include:

- controlled access to SRS through existing security gates and perimeter fences
- signs posted in the area to indicate that groundwater in the vicinity of the unit has been contaminated by hazardous materials
- deed notification to any future landowner of groundwater contamination, as required under CERCLA Section 120(h)

Although institutional controls are inclusive of the alternatives (except the no-action alternative), the DOE has recommended that residential use of SRS land in the vicinity of D Area be prohibited (DOE, 1996); therefore, future residential use and potential residential water usage in this area is unlikely. Modeling of groundwater alternatives, indicates that MCLs for the contaminants of concern will be met in the D-Area OSB groundwater in approximately 10 years. Upon confirmation that RGOs have been achieved, neither the institutional controls at the unit nor the 5-year ROD reviews will be required any longer.

Natural attenuation could effectively treat D-Area OSB groundwater. Results from bioventing testing indicate that the source of groundwater contamination (the D-Area OSB soil) is abated and no longer contributes to groundwater contamination. Evidence presented in the RFI/RI and BRA indicated that natural degradation is occurring in D-Area OSB groundwater. Herbert et al., 1984, report that natural attenuation can be selected as a preferred remedial option when the following site-specific conditions exist:

- Groundwater is unsuitable for consumptive use.
- Contaminants degrade quickly or are not at highly toxic concentrations.
- There is low potential for exposure.
- Active restoration is not feasible due to complex hydrogeologic conditions.
- There is low projected demand for future groundwater use.
- The unit is in close proximity to a surface water discharge area, with dilution to levels that are protective of human health and the environment.

The RFI/RI conducted at the D-Area OSB revealed the following:

- The source of contamination at the D-Area OSB was removed during IRA in conjunction with the biovent testing and no longer contributes to groundwater contamination.
- Naturally occurring mechanisms will continue to reduce contaminant concentrations.
- There are no receptors of groundwater at the D-Area OSB; therefore, there is low potential for exposure.
- The aquifer is limited in thickness and yield and is not targeted for residential or commercial use; therefore, projected demand for future groundwater use is low.
- Modeling indicates that contaminant concentrations in the D-Area OSB groundwater would be reduced to below MCLs prior to discharging to Fourmile Branch; therefore dilution in the surface water body is not necessary to achieve MCLs.

Based on this information the contaminants in the D-Area OSB would be conducive to natural attenuation.

Howard (1990) reports that the half-lives for PCE range from one to two years, for TCE range from 1.5 months to 4.5 years, for cis-1,2-DCE range from eight weeks to eight years, for vinyl chloride range from eight weeks to eight years, and for methylene chloride range from 14 days to eight weeks. The groundwater modeling effort utilized contaminant degradation rates from the higher limit (slower degradation) of the range of half-lives for each contaminant. Therefore, degradation times in the model output were conservatively estimated to be longer than expected in the field. These model results indicate that all contaminants should be below their respective MCLs within approximately 10 years. The primary conclusions of the groundwater modeling effort include the following:

1. Degradation is more effective at removing contaminant mass than the simulated extraction wells.

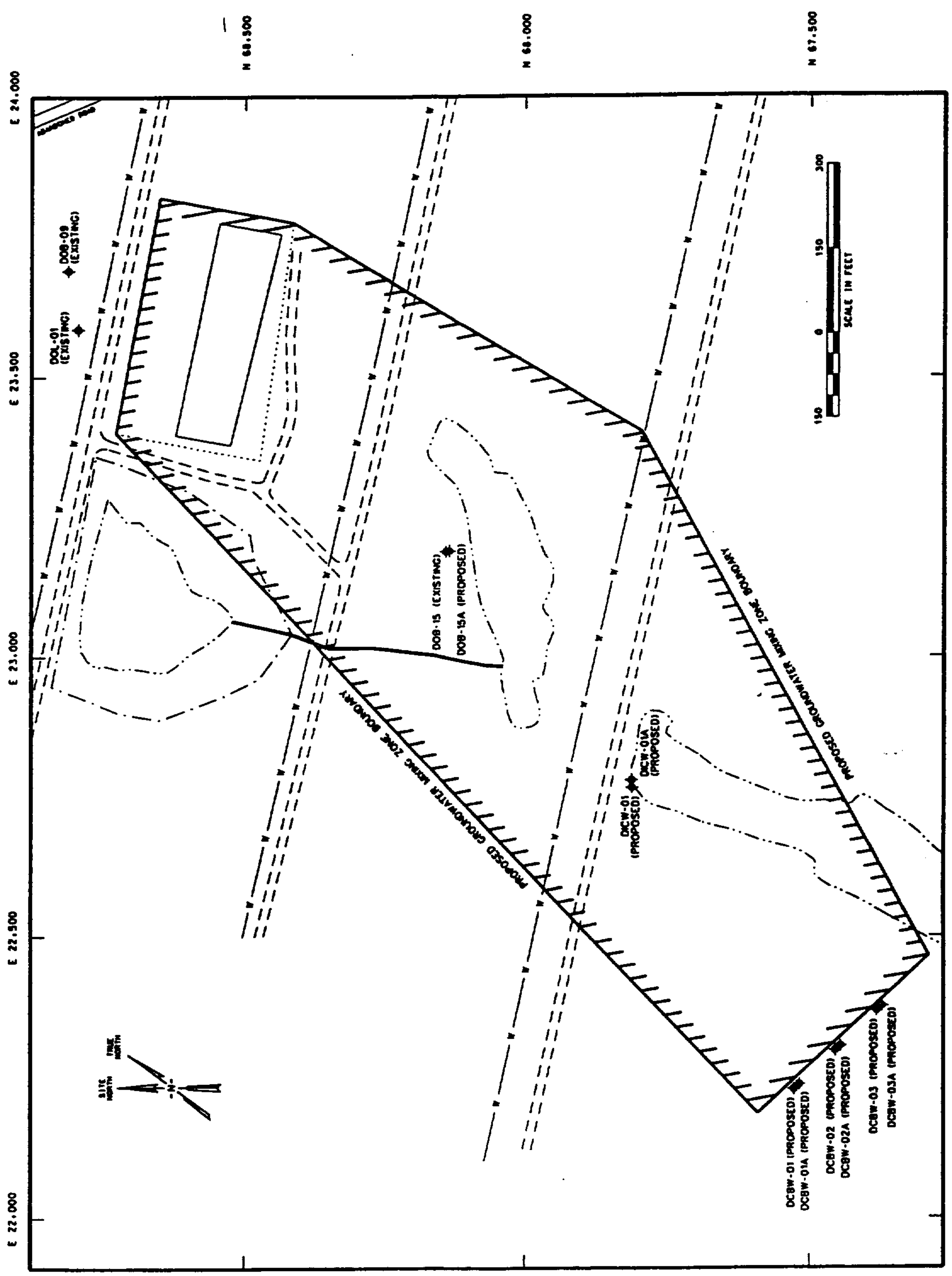

Figure 17. Proposed GWMZ with Monitoring Well Locations

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2. None of the contaminants simulated (DCE, TCE, PCE, and vinyl chloride) ever reached Fourmile Branch, regardless of the modeled scenario.

3. Model runs that included degradation indicated that the maximum time required for contaminants to reach MCLs was approximately 10 years.

4. Under most scenarios modeled (pumping, non-pumping, degradation, and no degradation), plumes do not migrate beyond their current extent.

According to the *Ground-Water Mixing Zone Guidance Document* (SCDHEC, 1997), a GWMZ application must demonstrate that the unit will meet the following four criteria:

1. "reasonable measures have been taken or binding commitments are made to minimize the addition of contaminants to groundwater and/or control the migration of contaminants in groundwater";

2. "the groundwater in question is confined to a shallow geologic unit that has little or no potential of being an Underground Source of Drinking Water, and discharges or will discharge to surface waters without contravening the surface water standards set forth in this regulation";

3. "the contaminant(s) in question occurs on the property of the applicant, and there is minimum possibility for groundwater withdrawals (present or future) to create drawdown such that contaminants would flow off-site";

4. "the contaminants or combination of contaminants in question are not dangerously toxic, mobile, or persistent."

A GWMZ application has been approved by the SCDHEC that demonstrates how D-Area OSB meets these four criteria. Based on area characteristics and evidence presented in the GWMZ Application, a GWMZ for the D-Area OSB is an appropriate part of natural attenuation remedies.

Based on data from monitoring wells around the D-Area OSB and groundwater transport modeling (WSRC, 1997b, Appendix B), remedial goal objectives will be met and MCLs will not be exceeded beyond the GWMZ. This alternative will reduce the risks associated with groundwater ingestion, dermal contact, and inhalation by ensuring that through natural GWMZ processes, the nearest groundwater receptor is not exposed to groundwater contaminated above MCLs.

Capital costs associated with natural attenuation would include the installation of nine new monitoring wells. Wells would be sampled quarterly the first year and semiannually thereafter. Operation and maintenance costs would include groundwater monitoring, maintenance of institutional controls, and a review of remedy every five years until contaminant concentrations are reduced to below their MCLs within the mixing zone. Transport modeling of DCE, PCE, TCE, and vinyl chloride indicates that this will be achieved in approximately 10 years. The total estimated cost associated with natural attenuation is $391,000.

Alternative GW-3 - Bioremediation with Institutional Controls

Under this alternative, groundwater would be extracted from the leading edge of the plume, oxygen and other nutrients would be added, and then the supplemented water would be injected back into the plume area via injection wells. Institutional controls would be maintained as part of this alternative to prohibit access to unit groundwater (i.e., SRS security, sign posting, and deed notifications). Groundwater monitoring would also be conducted to monitor contaminant concentrations and any migration.

This alternative would utilize the same natural processes as natural attenuation, discussed in the previous subsection. Bioremediation would involve the injection of oxygen and nutrients into the subsurface, which should expedite natural biodegradation processes. Based on unit conditions and modeling results, bioremediation could effectively reduce contaminant concentrations in less than ten years.

Following addition of nutrients and oxygen, groundwater would be injected into the aquifer. Injection would require a variance to inject water exceeding MCLs.

Components of Alternative GW-3 include installation of new monitoring wells, a groundwater extraction system, an oxygen/nutrient addition system, and wells through which the treated groundwater would be reinjected. Operation and maintenance costs associated with this alternative would include nutrients, operation, and groundwater monitoring (quarterly the first year and semiannually thereafter). It is estimated that this remedy will take less than ten years to reach MCLs. A review of remedy would be required at five and ten years. Estimated costs associated with Alternative GW-3 total $1,102,000.

Alternative GW-4a - Air Sparging Hot Spot Areas/GWMZ with Institutional Controls

Alternative GW-4a includes air sparging at the hot spot areas within the contaminant plume. COC concentrations in the hot spot areas would reduce rapidly, allowing natural subsurface processes, such as flushing, volatilization, biodegradation, adsorption, and chemical reaction with subsurface materials to reduce contaminant concentrations in the remaining contaminant plume. Based on physical properties of unit contaminants, air sparging would provide effective treatment. A GWMZ would be applied for under South Carolina Regulations R.61-68 as part of this alternative. This would create a specific area at the unit that would be required to meet MZCLs at plume monitoring wells. Downgradient compliance wells would be installed. Groundwater at this compliance boundary would be required to meet RGOs (equivalent to MCLs). Between the compliance boundary wells and the plume wells, intermediate wells will be monitored and compared to concentrations predicted by the fate and transport models. Vadose zone soils and groundwater would be monitored to determine contaminant removal rates. Institutional controls to restrict access to unit groundwater would be maintained as a component of Alternative GW-4a (i.e., SRS security, sign posting, and deed notifications). Groundwater contaminant concentrations would also be monitored to ensure that concentrations decrease as a result of treatment and contaminants do not migrate.

Costs associated with Alternative GW-4a include the labor and materials needed to construct the sparging system. Also included in the costs is operation and maintenance of the system and a remedy review every five years until clean-up levels are met. It is estimated that contaminant concentrations would be sufficiently reduced through air sparging in less than 10 years. Operation and maintenance would include air, soil, and groundwater monitoring, and operation. Groundwater would be sampled quarterly the first year and semiannually thereafter. Estimated costs associated with Alternative GW-4a total $1,080,000.

Alternative GW-4b - Air Sparging with Institutional Controls

Air sparging would involve the injection of air into a series of wells in the area of the groundwater plume. The air would migrate upward through the aquifer in the form of bubbles. The air would volatilize VOCs and carry them up through and out of the aquifer, through the vadose zone, and into the atmosphere where they could be degraded (e.g., by photolysis). Vadose zone soils, as well as groundwater, would be monitored to determine contaminant removal rates. Nine additional monitoring wells would be installed as part of this alternative to monitor contaminant concentrations in groundwater. Institutional controls would be maintained to prevent access to unit groundwater. Based on physical properties of unit contaminants, air sparging would provide effective treatment.

Costs associated with Alternative GW-4b include the labor and materials needed to construct the sparging system. Also included in the costs is operation and maintenance of the system and a remedy review every five years until clean-up levels are met. It is estimated that contaminant concentrations would be sufficiently reduced through air sparging in less than 10 years. Operation and maintenance would include air, soil, and groundwater monitoring, and operation. Groundwater would be sampled quarterly the first year and semiannually thereafter. Estimated costs associated with Alternative GW-4b total $1,144,000.

Alternative GW-5 - Extraction/Stripping/Discharge with Institutional Controls

This alternative would generally require three components: an extraction system, a treatment system, and a discharge system. Institutional controls and groundwater monitoring would also be implemented and maintained as a component of this alternative.

Extraction System

Contaminated groundwater would be extracted using either extraction wells or interceptor trenches. For purposes of this document, extraction wells will be considered the preferred extraction technique. Selection of the appropriate extraction system would be determined during Corrective Measures/Remedial Design. The objective of extraction would be to capture groundwater contaminants. Based on groundwater quality data from the RI, contaminants are limited to the upper two aquifers, which are both located above the "green clay" confining unit (Figure 10). An extraction system would, therefore, have wells that are screened in the upper two aquifers.

Modeling of groundwater extraction indicated that two extraction wells would be necessary downgradient of the plume. The extraction well located in the upper aquifer would be pumped at approximately 3 gallons per minute and the lower well would be pumped at approximately 2 gallons per minute. As part of this alternative, new monitoring wells would be installed to confirm reduction in concentrations of contaminants.

Groundwater extraction has been proven effective in containing groundwater plumes. Based on the high hydraulic conductivity in the impacted area of the aquifer, extraction wells would be effective at this unit. Modeling indicates that clean-up levels could be reached in 9 years (with degradation) to 25 years (without degradation).

Air Stripping

Air stripping is a physical process in which volatile compounds in groundwater are transferred to an air stream, typically using a packed tower. Compounds with a Henry's Law Coefficient (H_C) greater than 0.01 are readily stripped. 1,2-DCE (cis and trans), methylene chloride, PCE, TCE, and vinyl chloride have H_Cs of 0.29, 0.13, 1.08, 0.38, and 3.4, respectively. Therefore, DCE, methylene chloride, PCE, TCE, and vinyl chloride would be effectively removed through air stripping. Air stripping would effectively treat contaminated groundwater at the D-Area OSB.

Discharge

Under this alternative, treated groundwater would be discharged to an existing National Pollutant Discharge Elimination System (NPDES) permitted outfall or to infiltration galleries. For purposes of this document, it is assumed that treated groundwater would be discharged at the nearest existing NPDES outfall. Selection of the preferred discharge option would be conducted during Corrective Measures/Remedial Design.

An NPDES permit places a restriction or effluent limitation on the quantities, discharge rates, and/or concentrations of pollutants that may be discharged into surface waters. Therefore, the effluent limitations specified in the existing NPDES permit would determine the type and extent of treatment required prior to a discharge.

Costs associated with this alternative would include the labor and materials needed to construct new monitoring wells, an extraction system (assumed extraction wells), an air stripping system, a discharge line to the NPDES outfall, and modification of an existing NPDES permit. Operation and maintenance costs for the system include operation of the system, groundwater monitoring, maintenance of institutional controls, and a remedy review at five years, which is the estimated time required to meet RAOs. The estimated costs associated with this alternative total $1,309,000.

VIII. SUMMARY OF COMPARATIVE ANALYSIS OF THE ALTERNATIVES

Each of the remedial alternatives was evaluated using the nine criteria established by the NCP [40 CFR § 300.430 (e) (9)]. The criteria were derived from the statutory requirements of CERCLA Section 121, to provide the basis for evaluating alternatives and selecting a remedy. The nine criteria are listed below:

- overall protection of human health and the environment
- compliance with ARARs
- long-term effectiveness and permanence
- reduction of toxicity, mobility, or volume through treatment
- short-term effectiveness
- implementability
- cost
- state acceptance
- community acceptance

In selecting the preferred alternative, the above mentioned criteria were used to evaluate the alternatives developed in the *Corrective Measures Study/Feasibility Study for the D-Area Oil Seepage Basin (631-G) (U)* (WSRC, 1998a). Seven of the criteria are used to evaluate all the alternatives based on human health and environmental protection, cost, and feasibility issues. The preferred alternative is further evaluated based on the final two criteria: state acceptance and community acceptance. The comparative analysis for the five groundwater alternatives, using the first seven criteria, is presented in Table 6. Brief descriptions of the nine criteria are provided below, followed by a brief comparison of soil and groundwater alternatives based on the criteria.

Table 6
Comparative Analysis of Groundwater Alternatives

Criterion	Alternative GW-1 No Action	Alternative GW-2 Natural Attenuation/GW Mixing Zone with Institutional Controls	Alternative GW-3 Bioremediation with Institutional Controls	Alternative GW-4a Air Sparging Hot Spots/GW Mixing Zone with Institutional Controls	Alternative GW-4b Air Sparging with Institutional Controls	Alternative GW-5 Extraction/Air Stripping/ Discharge with Institutional Controls
Overall Protection of Human Health and the Environment						
Human Health	Not protective without existing institutional controls and groundwater monitoring	Protective	Protective	Protective	Protective	Protective
Environment	Protective	Protective	Protective	Protective	Protective	Protective
Compliance with ARARs						
Chemical-Specific	Does not meet MCLs	Will meet MCLs following treatment	Will meet MCLs following treatment	Will meet MCLs following treatment	Will meet MCLs following treatment	Will meet MCLs following treatment
Location-Specific	Not applicable	Wetland Protection	Wetland Protection	Wetland Protection	Wetland Protection	Wetland Protection
Action-Specific	Not applicable	Will meet MZCLs at intermediate wells and MCLs at compliance boundary wells	Variance required to inject waters exceeding MCLs	State air requirements; MZCLs will be met at intermediate wells and MCLs at compliance boundary wells	State air requirements	State air requirements NPDES modification
Long-Term Effectiveness and Permanence						
Magnitude of Residual Risks	Residual risks would remain uncontrolled	Contaminants would be removed; minimal residual risk	Contaminants would be removed; minimal residual risk	Contaminants would be removed; minimal residual risk	Contaminants would be removed; minimal residual risk	Contaminants would be removed; minimal residual risk

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Table 6
Comparative Analysis of Groundwater Alternatives

Criterion	Alternative GW-1 No Action	Alternative GW-2 Natural Attenuation /GW Mixing Zone with Institutional Controls	Alternative GW-3 Bioremediation with Institutional Controls	Alternative GW-4a Air Sparging Hot Spots/GW Mixing Zone with Institutional Controls	Alternative GW-4b Air Sparging with Institutional Controls	Alternative GW-5 Extraction/Air Stripping/ Discharge with Institutional Controls
Adequacy of Controls	No controls would be provided	Institutional Controls and groundwater monitoring	Institutional Controls, groundwater monitoring, process controls, and conventional equipment requiring maintenance	Institutional Controls, groundwater monitoring, process controls, and conventional equipment requiring maintenance	Institutional Controls, groundwater monitoring, process controls, and conventional equipment requiring maintenance	Institutional Controls, groundwater monitoring, process controls, and conventional equipment requiring maintenance
Reduction of Toxicity, Mobility, or Volume through Treatment						
Toxicity	No active treatment	Reduced by natural attenuation; no active treatment	Reduced by biodegradation	Reduced by volatilization	Reduced by volatilization	Reduced by extraction and treatment
Mobility	No active treatment	Reduced by natural attenuation; no active treatment	Reduced by biodegradation	Reduced by volatilization	Reduced by volatilization	Reduced by extraction and treatment
Volume	No active treatment	Reduced by natural attenuation; no active treatment	Reduced by biodegradation	Reduced by volatilization	Reduced by volatilization	Reduced by extraction and treatment
Short-Term Effectiveness						
Risk to Remedial Workers	None	Minimal; workers protected under health and safety plan	Minimal; workers protected under health and safety plan	Minimal; workers protected under health and safety plan	Minimal; workers protected under health and safety plan	Minimal; workers protected under health and safety plan

Table 6
Comparative Analysis of Groundwater Alternatives

Criterion	Alternative GW-1 No Action	Alternative GW-2 Natural Attenuation /GW Mixing Zone with Institutional Controls	Alternative GW-3 Bioremediation with Institutional Controls	Alternative GW-4a Air Sparging Hot Spots/GW Mixing Zone with Institutional Controls	Alternative GW-4b Air Sparging with Institutional Controls	Alternative GW-5 Extraction/Air Stripping/ Discharge with Institutional Controls
Risk to Community	None	None	None	Minimal risk from air emissions	Minimal risk from air emissions	Minimal risk from air emissions
Risk to Environment	None	Minimal; precautions would be taken	Minimal; precautions would be taken	Minimal; precautions would be taken	Minimal; precautions would be taken	Minimal; precautions would be taken
Time to Achieve Remediation Goals	35 years	10 years	Less than 10 years	Less than 10 years	Less than 10 years	9 years
Implementability						
Ability to Construct and Operate	No implementation required	Readily Implemented	Readily constructed, but effectiveness during operation limited	Readily implemented	Readily implemented	Readily implemented
Ability to Obtain Approval	May cause regulatory or public concern	No concerns	May be difficult to obtain approval for reinjection	No concerns	No concerns	No concerns
Cost						
Capital Costs	-	$142,000	$594,000	$451,000	$491,000	$671,000
O&M Costs	$278,000	$299,000	$508,000	$629,000	$653,000	$638,000
Estimated Years of O&M	35	10	<10	<10	<10	9
Total Present Worth Costs	$278,000	$391,000	$1,102,000	$1,080,000	$1,144,000	$1,309,000

Overall Protection of Human Health and the Environment

The remedial alternatives are assessed to determine the degree to which each alternative eliminates, reduces, or controls threats to human health and the environment through treatment, engineering methods, or institutional controls.

All groundwater alternatives, except no action, would be protective of human health and the environment because they result in a decrease of contaminant concentrations and include institutional controls to restrict access to unit groundwater. The alternatives also include monitoring to verify that contaminants do not exceed target levels at compliance boundaries (if applicable) and that contaminant concentrations are decreasing. As contaminant concentrations decrease, risks to human health associated with ingestion, dermal contact, and inhalation of groundwater would be prevented. The BRA determined that groundwater contaminants do not pose a significant risk to ecological receptors. Additionally, modeling results indicate that the nearest surface water body downgradient of D-Area OSB will not receive groundwater contaminants at concentrations exceeding MCLs. Therefore, all alternatives are protective of the environment.

Compliance with ARARs

ARARs are federal and state environmental regulations that establish standards that remedial actions must meet. There are three types of ARARs: (1) chemical-specific, (2) location-specific, and (3) action-specific.

Chemical-specific ARARs are usually health- or risk-based levels or methodologies that, when applied to unit-specific conditions, result in the establishment of numerical values. Often these numerical values are promulgated in federal or state regulations.

Location-specific ARARs are restrictions placed on the concentration of hazardous substances or the conduct of activities solely because they are in specific locations. Some examples of specific locations include floodplains, wetlands, historic places, and sensitive ecosystems or habitats.

Action-specific ARARs are usually technology- or remedial activity-based requirements or limitations on actions taken with respect to hazardous substances or unit-specific conditions. These requirements are triggered by the particular remedial activities that are selected to accomplish a remedy.

In addition to complying with ARARs, other criteria, guidance, or proposed standards are "to be considered" even though they are not legally binding, because they may provide useful information or recommended procedures, when setting remedial objectives.

Under all groundwater alternatives, contaminant concentrations in groundwater would remain above current MCLs (chemical-specific ARARs) for the near future, but would meet MCLs following remediation. However, the no-action alternative would not provide monitoring to confirm when MCLs are reached.

No action-specific ARARs are associated with Alternative GW-1. Alternatives GW-2 and GW-4a would require compliance with the GWMZ. Alternative GW-3 would require a variance to inject groundwater exceeding MCLs. Such a variance may be difficult to obtain. State air quality regulations would apply to emissions from Alternatives GW-4a, GW-4b, and Alternative GW-5, but should not be difficult to meet. Alternative GW-5 may also require an NPDES permit modification, which should not be difficult to obtain. Alternatives GW-3, GW-4a, GW-4b, and GW-5 would also require construction permits, which should not be difficult to obtain.

No location-specific ARARs are associated with Alternative GW-1. The potential location-specific ARAR associated with Alternatives GW-2, GW-3, GW-4a, GW-4b, and GW-5 would require protection of the nearby wetlands.

Long-Term Effectiveness and Permanence

The remedial alternatives are assessed based on their ability to maintain reliable protection of human health and the environment after implementation.

All alternatives except the no-action alternative would result in a permanent reduction of contaminants to below remediation goals (MCLs) by an effective means of treatment. The no-action alternative would not provide treatment to reduce contaminant concentrations and would result in contaminants remaining at the unit above regulatory limits.

Process controls are available for Alternatives GW-3, GW-4a, GW-4b, and GW-5 that could adequately and reliably control each system. Alternative GW-2 would not require any process controls. All alternatives except no action would also utilize institutional controls and groundwater monitoring to restrict access to unit groundwater and monitor treatment effectiveness, respectively. The no-action alternative would provide no control over existing groundwater contamination.

Reduction of Toxicity, Mobility, or Volume Through Treatment

The remedial alternatives are assessed based on the degree to which they employ treatment that reduces toxicity (the harmful nature of the contaminants), mobility (ability of the contaminants to move through the environment), or volume of contaminants associated with the unit.

Alternative GW-1 would provide no treatment of groundwater contaminants. Alternative GW-2 would involve passive treatment through natural attenuation processes and would result in decreases in contaminant toxicity, mobility, and volume. Alternative GW-4a includes natural attenuation as part of the active treatment alternative. Alternatives GW-3, GW-4a, GW-4b, and GW-5 would provide active treatment of unit contaminants to reduce the toxicity, mobility, and volume of groundwater contaminants. Each alternative would result in reaching MCLs; the time frames required to reach MCLs are provided in the following section.

Short-Term Effectiveness

The remedial alternatives are assessed considering factors relevant to implementation of the remedial action, including risks to the community during implementation, impacts on workers, potential environmental impacts (e.g., air emissions), and the time required to achieve protection.

Remedial goals (MCLs) would be met by each alternative in the following time periods based on groundwater modeling (WSRC, 1998a, Appendix B), and professional experience:

- Alternative GW-1 35 years
- Alternative GW-2 10 years
- Alternative GW-3 <10 years
- Alternative GW-4a <10 years
- Alternative GW-4b <10 years
- Alternative GW-5 9 years

Alternative GW-1 would not require any remedial actions and would, therefore, not result in any risk to remedial workers. Of the remaining alternatives, Alternative GW-2 would result in the least risk to remedial workers and Alternative GW-5 would result in the most. However, no significant risks are associated with any of the alternatives and compliance with the health and safety plan should protect remedial workers during implementation.

Construction and implementation activities would not endanger the community for any of the alternatives. However, a minimal risk would be associated with Alternatives GW-4a, GW-4b, and GW-5 due to air emissions from the treatment systems. However, compliance with air regulations would provide protection to the community.

All alternatives except no action would involve some disturbance to the environment. This disturbance would be least for Alternative GW-2 and greatest for Alternative GW-5. However, precautions would be taken to minimize disturbance.

Implementability

The remedial alternatives are assessed by considering the difficulty of implementing the alternative including technical feasibility, constructability, reliability of technology, ease of undertaking additional remedial actions (if required), monitoring considerations, administrative feasibility (regulatory requirements), and availability of services and materials.

All alternatives could be readily implemented with no difficulty obtaining materials or equipment. All alternatives except the no action alternative would provide an effective means of treatment and groundwater monitoring to evaluate treatment effectiveness. The added effectiveness provided by injecting nutrients under Alternative GW-3 would likely be limited due to subsurface heterogeneities and preferential pathways that would develop. It would also be difficult to evaluate overall performance because the areas of preferential pathways will have increased bioactivity. None of the alternatives would preclude any further remedial action, should it be deemed necessary in the future. All alternatives except no action would require approval of permits or variances. Obtaining approval is not anticipated to be difficult for any of these alternatives except Alternative GW-3, which would require a variance to inject groundwater exceeding MCLs. However, obtaining such a variance would not likely prevent implementation of the alternative.

Cost

The evaluation of remedial alternatives must include capital, operational, and maintenance costs. Present value costs are estimated within +50/-30 percent, per EPA guidance. The cost estimates given with each alternative are prepared from information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, actual site conditions, productivity, competitive market conditions, final project scope, final project schedule, and other variable factors. As a result, the final project costs may vary from the estimates presented herein.

For ease of comparison, the total estimated present worth costs for each alternative are listed below:

Alternative GW-1	$278,000
Alternative GW-2	$391,000
Alternative GW-3	$1,102,000
Alternative GW-4a	$1,080,000
Alternative GW-4b	$1,144,000
Alternative GW-5	$1,309,000

State Acceptance

In accordance with the FFA, the state is required to comment on and approve the RFI/RI Report and BRA, the CMS/FS, and the SB/PP. State acceptance of previous documentation as listed above has been obtained. Also, state acceptance of the GWMZ application has been obtained, as well.

Community Acceptance

Community acceptance of the preferred alternative is assessed by giving the public an opportunity to comment on the remedy selection process. A public comment period was held from May 1, 1998 to June 14, 1998 during which comment was invited from the general public. No comments were received during this time. The ER&WM Program subcommittee of the SRS CAB was given a briefing on the preferred alternatives on May 6, 1998. The ER&WM subcommittee was supportive of the preferred alternative and made a motion to the full CAB at the May 18, 1998 meeting to accept the preferred alternative. This motion was accepted with no opposition. The subcommittee also commended the site's successful use of the bioventilation system in the remediation of the unit's subsurface soil.

IX. THE SELECTED REMEDY

The selected remedy for the D-Area OSB deep soils is No Further Action, since RAOs have been achieved by the IRA and biovent testing.

The selected remedy for shallow soil, surface water, and sediment is No Action, because no COCs in those media were identified in the RFI/RI/BRA.

The selected remedy for D-Area OSB groundwater is Alternative GW-2: Natural Attenuation/ GWMZ with Institutional Controls. Under this alternative, natural attenuation mechanisms such as biodegradation, flushing, volatilization, adsorption, and hydrolysis would continue to reduce contaminant concentrations in the groundwater to acceptable levels. Results from the bioventing study, conducted as part of the interim action, indicate that the source of groundwater contamination (i.e., the D-Area OSB soil) was abated as a result of the combined interim action and biovent test, and no longer contributes to groundwater contamination. Evidence indicating that natural attenuation processes are occurring in the D-Area OSB groundwater was presented in the RFI/RI Report and BRA and included: (1) decreased dissolved oxygen levels in groundwater, which indicates that microorganisms are utilizing a combination of the contaminants as a carbon source and oxygen within the groundwater as an oxygen source to produce energy, (2) elevated chemical oxygen demand, chloride, and sulfate levels downgradient, (3) depressed pH levels in contaminated areas, and (4) presence of breakdown products.

Researchers report that natural attenuation is appropriate for sites with certain characteristics and emphasis on the removal of the contaminant source and the ability of the specific contaminants to naturally degrade. Herbert et al., 1984, report that natural attenuation can be selected as a preferred remedial option when the following site-specific conditions exist:

- Groundwater is unsuitable for consumptive use.
- Contaminants degrade quickly or are not at highly toxic concentrations.
- There is low potential for exposure.
- Active restoration is not feasible due to complex hydrogeologic conditions.
- There is low projected demand for future groundwater use.
- The unit is in close proximity to a surface water discharge area, with dilution to levels that are protective of human health and the environment.

The RFI/RI conducted at the D-Area OSB revealed the following:

- The source of contamination at the D-Area OSB was removed during IRA in conjunction with the biovent testing and no longer contributes to groundwater contamination.
- Naturally occurring mechanisms will continue to reduce contaminant concentrations.
- There are no receptors of groundwater at the D-Area OSB; therefore, there is low potential for exposure.
- The aquifer is limited in thickness and yield and is not targeted for residential or commercial use; therefore, projected demand for future groundwater use is low.

- Modeling indicates that contaminant concentrations in the D-Area OSB groundwater would be reduced to below MCLs prior to discharging to Fourmile Branch; therefore dilution in the surface water body is not necessary to achieve MCLs.

Based on this information the contaminants in the D-Area OSB would be conducive to natural attenuation.

The time required to degrade the unit-specific contaminants was conservatively estimated through groundwater modeling. The modeling indicates that all contaminants in groundwater would be reduced below their respective MCLs within approximately 10 years, which is well within the time-frame that DOE plans to maintain control of the SRS.

A GWMZ application, defined under the South Carolina Regulations R.61-68, has been approved by the SCDHEC as part of this alternative (Figure 17). Mixing zones are considered in situations where the source of groundwater contamination has been removed and contaminant concentrations are decreasing by natural processes. This alternative will demonstrate through monitoring that RAOs will be met, MZCLs (Table 7) will be achieved throughout the aquifer, MCLs will be achieved at the compliance boundary, and predicted concentrations will be achieved at intermediate wells, as described in the approved GWMZ application. Implementation of this alternative involves installation of nine new wells and monitoring of a total of 12 groundwater wells. Based on area characteristics and evidence presented in the GWMZ Application, a GWMZ for the D-Area OSB is an appropriate part of a natural attenuation remedy and has been approved by the SCDHEC.

The D-Area OSB is in an industrial use zone, as identified in Figure 3.3 of the SRS FFA Implementation Plan (WSRC, 1996e), for both current and anticipated future land use. Although the remediation decisions for this unit were based on the industrial use scenario, the groundwater remedy will achieve the more protective residential use scenario. The D-Area OSB currently meets unrestricted land use criteria for soils, sediment and surface water. Groundwater beneath the unit exceeds the MCLs. Although institutional controls are included in all of the alternatives (except the no-action alternative), the DOE has recommended that residential use of SRS land in the vicinity of D Area be prohibited (DOE, 1996); therefore, future residential use and potential residential water usage in this area is unlikely. Modeling of groundwater transport processes as part of the evaluation of the remedial alternatives indicates that MCLs for the contaminants of concern will be achieved in all areas of the D-Area OSB groundwater after approximately 10 years. Upon confirmation that MCLs have been achieved, institutional controls at the unit will no longer be required.

Per the EPA Region-IV LUCs Policy, a LUCAP for SRS and a LUCIP for the D-Area OSB will be developed and submitted to the regulators for approval. The LUCAP will be submitted under separate cover, whereas the LUCIP will be submitted with the RDWP/ RDR/ RAWP in accordance with the post-ROD document schedule provided in Figure 18. The LUCIP details how SRS will implement, maintain, and monitor the land use control elements of the D-Area OSB ROD to insure that the remedy remains protective of human health.

The LUC objective necessary to ensure the protectiveness of the preferred alternative is:

- Prevent unauthorized access to the D-Area OSB contaminated groundwater plume.

The institutional controls required to prevent unauthorized exposure to the contaminated media at the D-Area OSB include the following:

- controlled access to the D-Area OSB through existing SRS security gates and perimeter fences and the site use/site clearance programs
- signs posted in the area to indicate that groundwater in the vicinity of the unit has been contaminated by hazardous materials
- notification of groundwater contamination to any future landowner through deed notification, as required under CERCLA Section 120(h)

A certified survey plat of the site will be prepared by a registered land surveyor and will be included with the post-ROD documents. If D-Area OSB is transferred to non-Federal ownership prior to remediation of the groundwater to the MCLs for the COCs, reevaluation of the need for deed restrictions would be performed through an amended ROD with EPA and SCDHEC approval. The survey plat will be reviewed and updated, as necessary, at the time the site is transferred and will be recorded with the appropriate county recording agency. The D-Area OSB is located in Aiken County.

Along with the institutional controls identified above, implementation of the selected remedy will involve the placement of compliance boundary monitoring wells between the basin and the downgradient stream and periodic monitoring of these compliance wells against the MCLs. This alternative will meet RAOs. MZCLs will be achieved throughout the aquifer and MCLs will be achieved at the compliance point as described in the approved GWMZ application. All monitoring, compliance, and reporting requirements to satisfy the GWMZ demonstration should be met in accordance with Section 5 of the approved GWMZ application.

Table 7

MZCLs and MCLs for COCs

Constituent of Concern	MZCL (µg/l)	MCL (µg/l)
Tetrachloroethene	85	5.0
Trichloroethene	1150	5.0
Cis-1,2-Dichloroethene	457	70.0
1,1-Dichloroethene	7.0	7.0
Total-1,2-Dichloroethene	70.0	70.0
Vinyl Chloride	32	2.0
Benzene	6.2	5.0
Methylene Chloride	9.5	5.0

X. STATUTORY DETERMINATIONS

The selected remedy for the D-Area OSB deep soils is No Further Action, since RAOs have been achieved by the IRA and biovent testing.

The selected remedy for shallow soil, surface water, and sediment is No Action, because no COCs in those media were identified in the RFI/RI/BRA.

Based on the findings of the D-Area OSB RI and BRA, groundwater contaminants present a risk to human health through ingestion, dermal contact, and inhalation. Modeling of unit groundwater indicates that naturally occurring processes, such as flushing, volatilization, biodegradation, adsorption, and chemical reaction with subsurface materials, would effectively reduce contaminant concentrations in groundwater to target levels within approximately 10 years. Monitoring wells would be used to verify that MCLs are not exceeded at compliance boundaries and that MZCLs would not be exceeded in the area of the contaminant plumes. Institutional controls would be maintained to limit access to unit groundwater until MCLs are satisfied. Natural attenuation is the most cost effective remedy for D-Area OSB unit groundwater.

The selected remedies for all media are protective of human health and the environment, complies with federal and state requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost-effective. These remedies can be easily implemented with minimal risk to remedial workers, the community, and the environment. These remedies would also provide a permanent solution to unit contamination that would not require any future remedial actions and satisfy the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element.

XI. EXPLANATION OF SIGNIFICANT CHANGES

The SB/PP provides for involvement with the community through a document review process and a public comment period. No comments were received during the 45-day public comment period. Therefore, there have been no significant changes to the selected remedy as a result of public comments.

XII. RESPONSIVENESS SUMMARY

No comments were received during the public comment period (May 1 to June 14, 1998). This is indicated in the Responsiveness Summary (Appendix A).

XIII. POST-ROD DOCUMENT SCHEDULE

The post-ROD document schedule, based on calendar days, is listed below and is illustrated in Figure 18.

1. The combined Revision 0 RDWP/RDR/RAWP Report for the D-Area OSB will be scoped 45 days after the ROD is approved, if determined by all three parties to be necessary.
2. RDWP/RDR/RAWP Report will be submitted to EPA and SCDHEC within 180 days of approval of the ROD. This report will contain the LUCIP, as part of the submittal.
3. EPA and SCDHEC review of the D-Area OSB RDWP/RDR/RAWP Revision 0 Report will be completed 90 days from submittal of the document.
4. SRS revision of the D-Area OSB RDWP/RDR/RAWP Report will be completed 60 days after receipt of all regulatory comments.
5. EPA and SCDHEC final review and approval of the D-Area OSB RDWP/RDR/RAWP Revision 1 Report will extend to 30 days after receipt of the Rev. 1.0 document.
6. D-Area OSB Remedial Action Field Start will begin on September 3, 1999, following EPA and SCDHEC approval of the Rev 1.0 RDWP/RDR/RAWP Report.
7. D-Area OSB PCR/FRR Revision 0 will be submitted to EPA and SCDHEC 90 calendar days after completion of the remedial action.
8. EPA and SCDHEC review of the D-Area OSB PCR/FRR will last 90 calendar days.
9. SRS revision of the D-Area OSB PCR/FRR will be completed 60 calendar days after receipt of all regulatory comments.
10. EPA and SCDHEC final review and approval of the Revision 1 PCR/FRR will last 30 calendar days.

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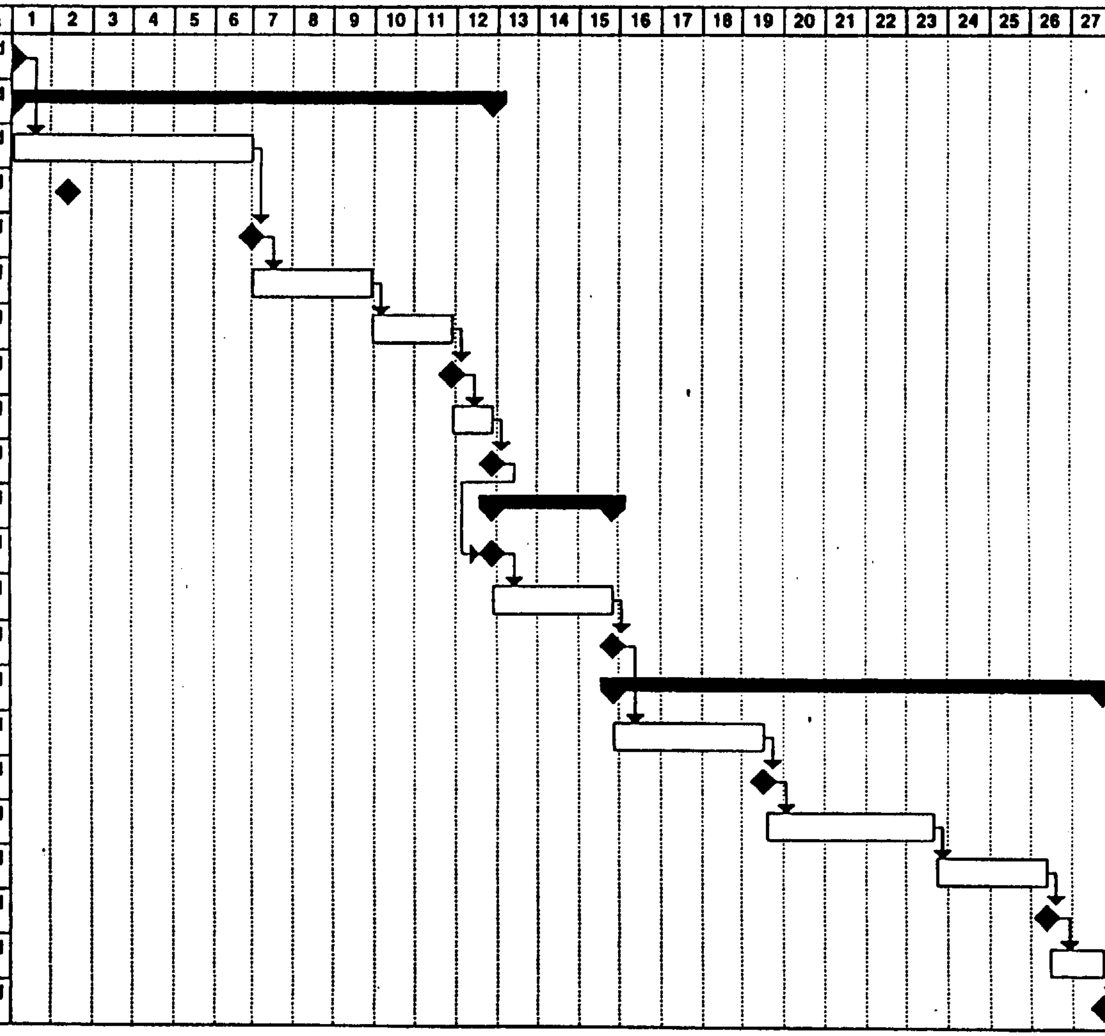
ID	Task Name	Days
1	EPA / SCDHEC Issue ROD	0d
2	**RDWP/RDR/RAWP Rpt***	**360d**
3	SRS Develop Rev 0 RDWP/RDR/RAWP Rpt	180d
4	Scope RDWP/RDR/RAWP Rpt, (if needed)	0d
5	SRS Submit Rev 0 RDWP/RDR/RAWP Rpt	0d
6	EPA / SCDHEC Review Rev 0 Rpt	90d
7	SRS Develop Rev 1 RDWP/RDR/RAWP Rpt	60d
8	SRS Submit Rev 1 RDWP/RDR/RAWP Rpt	0d
9	EPA / SCDHEC Review Rev 1.0 Rpt	30d
10	EPA / SCDHEC Approves Rev 1.0 Rpt	0d
11	**Construction Activities**	**90d**
12	RA Field Start	0d
13	Const Activities (clearing, well inst, ...)	90d
14	RA Field Completion	0d
15	**Post-Constr Rpt / Final Rem Rpt**	**270d**
16	SRS Develop Rev 0 PCR/FRR	90d
17	SRS Submit Rev 0 PCR/FRR	0d
18	EPA / SCDHEC Review	90d
19	SRS Develop Rev 1 PCR/FRR	60d
20	SRS Submit Rev 1 PCR/FRR	0d
21	EPA / SCDHEC Review	30d
22	EPA / SCDHEC Approval	0d



* Includes the Conceptual Corrective Action Strategy and the LUCIP

Figure 18. Post-ROD Schedule

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APPENDIX A

RESPONSIVENESS SUMMARY

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RESPONSIVENESS SUMMARY

The public was notified of the public comment period through mailings of the *SRS Environmental Bulletin*, a newsletter sent to approximately 3500 citizens in South Carolina and Georgia, through notices in the *Aiken Standard*, the *Allendale Citizen Leader*, the *Augusta Chronicle*, the *Barnwell People-Sentinel*, and *The State* newspapers. The public comment period was also announced on local radio stations.

The 45-day public comment period began on May 1, 1998 and ended on June 14, 1998. However, no public comments were received during this period.